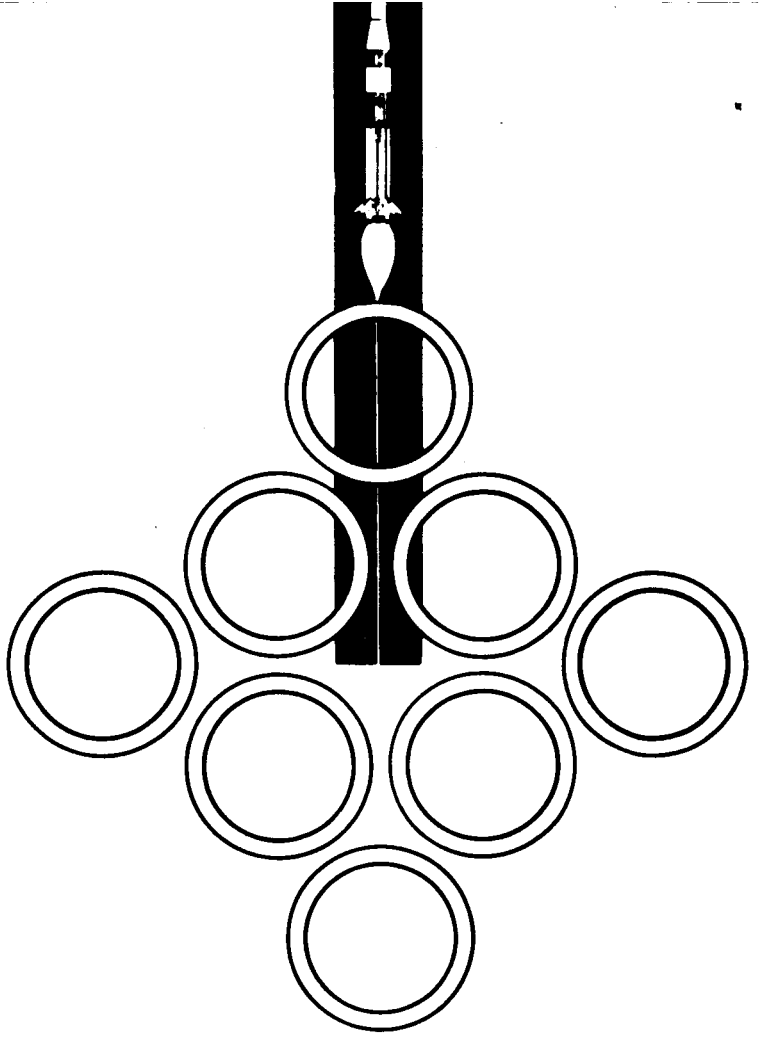

ENGINEERING DEPARTMENT

TECHNICAL REPORT

TR-RE-CCSD-FO-1045-3

February 17, 1967

SATURN IB PROGRAM

TEST REPORT
FOR

GLOBE VALVE, 1 ½-INCH, 100 PSIG, PNEUMATICALLY OPERATED

Annin Company Model Number 176C-1501bASA

NASA Drawing Number 75M13138 HCLV-3

SPACE DIVISION CHRYSLER CORPORATION

TEST REPORT

FOR

GLOBE VALVE, 1-½-INCH, 100-PSIG, PNEUMATICALLY OPERATED

Annin Company Model Number 1760-1501bASA

NASA Drawing Number 75M3138 HCLV-3

ABSTRACT

This report presents the results of tests performed on three samples of the Globe Valve 75M3138 HCLV-3. The following tests were performed.

1. Receiving Inspection
2. Proof Pressure
3. Functional
4. Temperature Shock
5. Insulation Resistance
6. Icing
7. Sand and Dust*
8. Salt Fog*
9. Cycle

The three specimens tested failed to meet the requirements of the John F. Kennedy Space Center as stated in TP-RE-CCSD-FO-1045-2R and NASA Drawing Number 75M13138 HCLV-3. The following failures were revealed during testing:

1. Receiving Inspection

   a. Damaged specimens and shipping containers revealed that inadequate containers were used to support and protect the specimens during shipment.

   b. Missing parts, loose assemblies and improper signal pressure calibration indicate a failure to ascertain good workmanship.

2. Functional Operation

   Two specimens failed to meet and maintain the minimum signal pressure requirement of **2.9 psig.**

3. Cycle

   Three specimens failed to meet minimum internal leakage requirements of 15 sccm upon completion of 1,000 cycles of the 3,000 cycles required.

* During these tests, the Bourns position indicator was removed from the valves and only the position indicator was subjected to the tests.

TEST REPORT

FOR

GLOBE VALVE, 1-½-INCH, 100-PSIG, PNEUMATICALLY OPERATED

Annin Company Model Number 1760-1501bASA

NASA Drawing Number 75M13138 HCLV-3

February 17, 1967

CHRYSLER CORPORATION SPACE DIVISION - NEW ORLEANS, LOUISIANA

FOREWORD

The tests reported herein were conducted for the John F. Kennedy Space Center by Chrysler Corporation Space Division (CCSD), New Orleans, Louisiana. This document was prepared by CCSD under contract NAS8-4016, Part VII, CWO 271620.

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FOREWORD

The tests reported herein were conducted for the John F. Kennedy Space Center by Chrysler Corporation Space Division (CCSD), New Orleans, Louisiana. This document was prepared by CCSD under contract NAS8-4016, Part VII, CWO 271620.

LIST OF TABLES (continued)

CHECK SHEET

FOR

GLOBE VALVE, 1-½-INCH, 100-PSIG, PNEUMATICALLY OPERATED

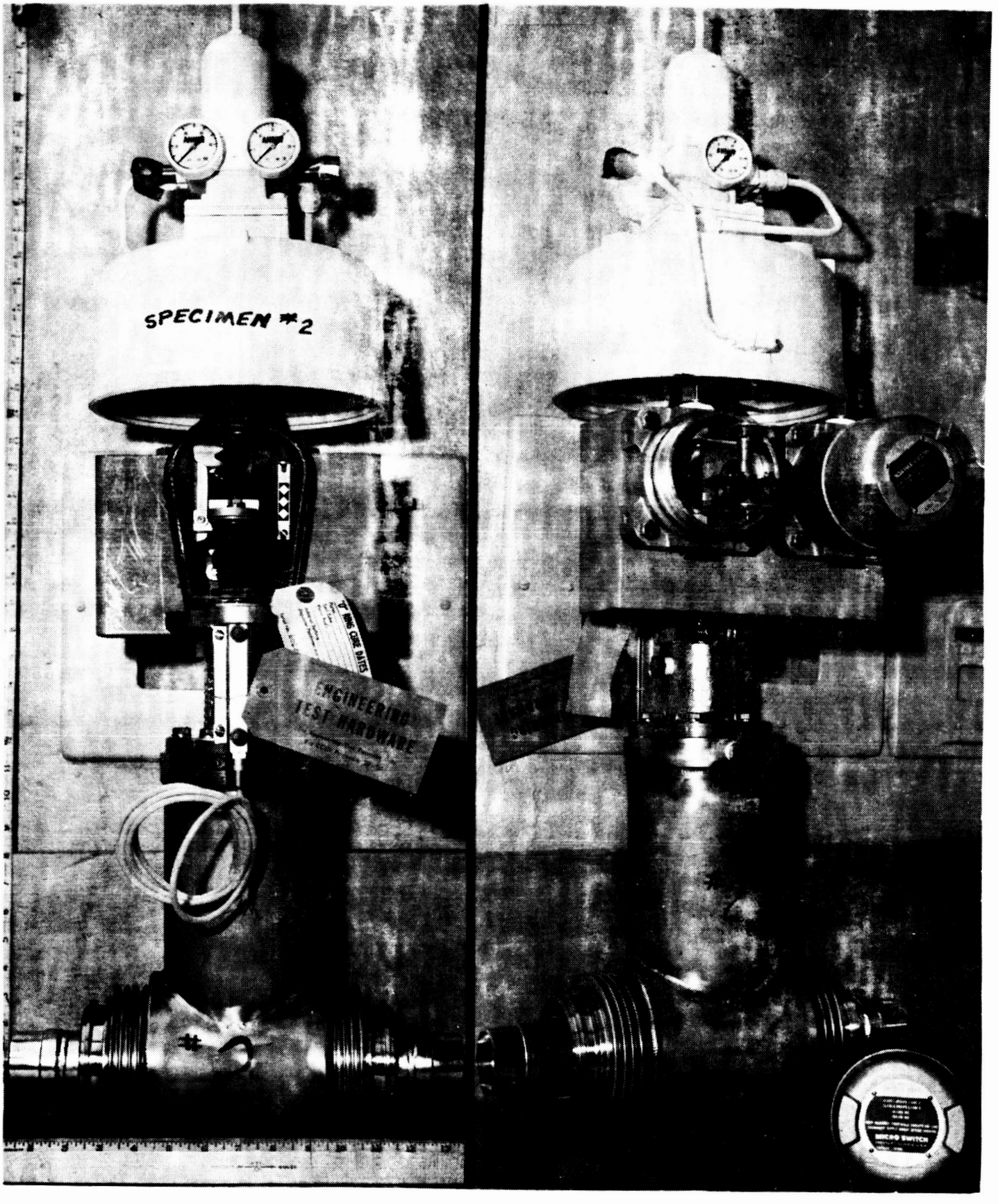
MANUFACTURER: The Annin Company
MANUFACTURER'S MODEL NUMBER: 1760-150lbASA
NASA DRAWING NUMBER: 75M13138 HCLV-3
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A.	OPERATING MEDIUM:	Valve: Liquid hydrogen Actuator: Gaseous nitrogen Indicator: Gaseous nitrogen
B.	OPERATING PRESSURE:	Valve: 100 psig Actuator: 50 psig; signal 3 to 15 psig Indicator: 50 psig
C.	VALVE CAPACITY:	$C_v = 13 \pm 0.5$
D.	LEAKAGE:	Internal - 15 sccm External - none
E.	VALVE OPERATION:	Vertical, pilot operated, and spring to close.
F.	VACUUM:	10 microns of Hg or less
G.	RESPONSE SPEED:	0.2 inch per second

II. CONSTRUCTION

A.	BODY, BONNET, AND JACKET MATERIAL:	Type 304 stainless
B.	VALVE TRIM:	Austenitic stainless
C.	VALVE YOKE:	Austenitic stainless
D.	SOFT SEAL PLUG INSERT:	Kel-F



Globe Valve, 75M13138 HGLV-3, 1½-Inch, 100-Psig, Pneumatically Operated

CHECK SHEET

FOR

POSITION INDICATOR

MANUFACTURER: Bourns Laboratories, Inc.
MANUFACTURER'S MODEL NUMBER: 156
TESTING AGENCY: Chrysler Corporation Space Division, New Orleans, Louisiana
AUTHORIZING AGENCY: NASA KSC

I. FUNCTIONAL REQUIREMENTS

A.	PURGE MEDIUM:	Dry GN_2
B.	RESISTANCE:	5,000 ohms $\pm$ 5%
C.	OPERATING PRESSURE:	50 psig

II. CONSTRUCTION

A.	WIRE TYPE	Evanohm
B.	CONNECTIONS:	Pressure - MS33356-2 Style "G" Electrical - 1/2-inch MPT
C.	SHAFT:	Stainless steel
D.	MOUNTING LUGS:	Stainless steel
E.	CASE:	Stainless steel
F.	END PLUGS:	Stainless steel

TEST SUMMARY (Sheet 1 of 2)
GLOBE VALVE, 1-½-INCH, 100 PSIG, PNEUMATICALLY OPERATED
75M13138 HCLV-3

Environment	Units	Operational Boundary	Test Objective	Test Results Specimen 1	Specimen 2	Specimen 3	Remarks
Receiving Inspection	3	Visual and Dimensional Examination	To determine if specimens conforms to vendor drawings A4951, P5483, P5833, and A4806. Examine for poor workmanship and manufacturing defects.	F	F	S	Specimens 1 and 2 complied with vendor drawings. Evidence of poor workmanship, improper packing and manufacturing defects was observed. Specimen 3 complied with vendor drawings. No evidence of poor workmanship, improper marking, and manufacturing defects was observed.
Proof Pressure Test	3	Valve Body - 150 psig for 5 minutes Actuator - 75 psig for 5 minutes Signal Port - 22 psig for 5 minutes Vacuum Jacket - 20 psig for 5 minutes Vacuum Jacket - $1X10^{-7}$ ATM cc/sec. Bourns Indicator - 75 psig for 5 minutes	Maintain all pressures	S S S S S F	S S S S S F	S S S S S F	Maintained all pressures and no leakage or distortion were observed. Bourns indicator not capable of holding pressure.
Functional Test	3	INTERNAL SEAT LEAKAGE - 15 SCCM FOR 5 MINUTES I. Upstream Pressure - 100 psig A) Actuator Pressure - 50 psig 1. Signal Pressure - 2.9 (+0, -0.1) psig B) Actuator Pressure - 20 psig 1. Signal Pressure - 2.9 (+0, -0.1) psig C) Actuator Pressure - 0.0 psig 1. Signal Pressure - 0.0 psig II. Downstream Pressure - 25 psig A) Actuator Pressure - 50 psig 1. Signal Pressure - 2.9 (+0, -0.1) psig B) Actuator Pressure - 20 psig 1. Signal Pressure - 2.9 (+0, -0.1) psig C) Actuator Pressure - 0.0 psig 1. Signal Pressure - 0.0 psig EXTERNAL LEAKAGE - NONE VACUUM JACKET - LESS THAN 10 MICRONS ACTUATOR SIGNAL - UPSTREAM PRESSURE 100 PSIG I. Actuator Pressure - 50 psig A) Signal Pressure - 3.0 to 15 psig II. Actuator Pressure - 20 psig A) Signal Pressure - 3.0 to 15 psig VALVE STEM MINIMUM TRAVEL SPEED - 0.2 INCH PER SECOND I. Actuator Pressure - 50 psig II. Actuator Pressure - 20 psig	Operate withing specification limits S S S S F S S S F F F F	 S S S S S S S S S S	 S S S S S S S S F F	SPECIMEN 1 Upstream Pressure at 100 psig. Failed to operate at actuator pressure of 20 psig. Downstream Pressure at 25 psig. Failed to seat at actuator pressure of 20 psig. Signal pressure of 2.8 psig. Valve cracked and reseated at less than 2.5 psig. SPECIMEN 3 Failed to meet functional test requirements. A signal pressure of 2.7 psig cracked valve and valve reseated at 2.6 psig signal pressure. A second functional test was completed at end actuator pressure of 25 psig and minimum signal pressure of 2.7 psig.

TEST SUMMARY (Sheet 2 of 2)
GLOBE VALVE, 1-½-INCH, 100 PSIG, PNEUMATICALLY OPERATED
75M13138 HCLV-3

Environment	Units	Operational Boundary	Test Objective	Test Results			Remarks
				Specimen 1	Specimen 2	Specimen 3	
		BOURNS INDICATOR PRESSURE - 50 PSIG					
		POSITION INDICATOR SWITCHES					
		I. Open		S	S	S	
		II. Closed					
Temperature Shock	2	Stabilize temperature at 125°F then cool within 2 minutes by flowing GH_2 and then LH_2	Determine if specimens's performance is impaired by temperature shock	NA	S	F	SPECIMEN 3 Minimum signal pressure out of tolerance.
Insulation Resistance Test	3	20 megohms, at 500 vdc for more than 60 seconds	To determine resistance between non connected terminals and case	S	S	S	All specimens successfully completed requirements.
Icing Test	2	Maintain 5°F Spray droplets, with a minimum diameter of 1.5 millimeters, at a minimum distance of 2 feet	To determine if specimen's performance is impaired by icing	NA	F	F	SPECIMEN 2 Leak on packing flange gland during icing Gland tightened. No leak on post icing functional test. SPECIMEN 3 Minimum signal pressure and actuator pressure out tolerance.
Sand and Dust Test (Bourns indicator only)	1	Maintain density level of sand and dust between 0.1 and 0.25 gram per cubic foot at an air velocity between 100 and 500 feet per minute. Temperatures of 77°F and 125°F for 2 hours at each temperature	To determine resistance of Bourns indicator to fine blowing sand and dust particles	S	NA	NA	Successfully completed requirements.
Salt Fog Test (Bourns indicator only)	1	Maintain temperature of 95°F (+2, -4°F using a salt solution consisting of 5 parts by weight of sodium chloride and 95 parts by weight of water for 240 hours	To determine resistance of Bourns indicator to a salt atmosphere	F	NA	NA	Failed during cycling due to salt fog deterioration.
Cycle Test	3	3000 cycles	To determine if specimen's performance is impaired by cycling	F	F	F	SPECIMEN 1 Tested with signal pressure of 2.4 to 15 psig and actuator, pressure of 50 psig. Failed on precycle functional test. Disassembly revealed springbutton adjusting assembly on domotor rotated. The specimen failed leakage tolerances after 1000 cycles. SPECIMEN 2 Tested with signal pressure of 2.9 to 15 psig Failed leakage tolerance at 1000 cycles Disassembly revealed valve plug (SS) and seal seat (Kel-F) worn, seal creavey (Teflon) compressed and pressure ring (SS) loose. SPECIMEN 3 Tested with signal pressure of 2.4 to 15 psig. Failed leakage tolerance upon completion of 3000 cycles. Bourns indicator on specimen 1 failed after 100 cycles due to the effects of salt fog environment.
Burst Pressure Test	2	Valve Body - 400 psig for 5 minutes Actuator - 200 psig for 5 minutes Signal Port - 60 psig for 5 minutes Bourns Indicator - 200 psig for 5 minutes	Maintain all pressures; and photograph all ruptures and failures				Burst Pressure Test cancelled due to possible further testing. No Burst Pressure Test performed due to failures.

SECTION I

INTRODUCTION

1.1 SCOPE

This report presents the results of tests that were performed to determine if Globe Valve 75M13138 HCLV-3 meets the operational requirements for John F. Kennedy Space Center Launch Complexes 34 and 37B. A summary of the test results is presented on pages x and xi.

1.2 ITEM DESCRIPTION

1.2.1 VALVE

1.2.1.1 Globe valve 75M13138 HCLV-3 is a 1-1/2-inch valve with 150-pound ASA raised-face flanges and is manufactured by The Annin Company, Montebellow, California. The valve serves as a control valve in the Saturn IB LH_2 replenishing system.

1.2.1.2 The valve is 10-1/2 inches face-to-face and approximately 37 inches from the bottom of the flange to the top of the actuator housing. The valve is vacuum jacketed and is pneumatically operated from an isolated signal source. The valve body is a one piece pattern with integral seat and extension bonnet. There are no mechanical joints within the vacuum jacket. The fluid medium flows down over the seat and can be throttled while flowing. The normal valve flow medium is liquid hydrogen and the actuator medium is gaseous nitrogen. The actuator is a spring-to-close type and will close in any instance of actuator or signal pressure failure. Two explosion-proof, snap-action switches enclosed in weatherproof housing are incorporated to indicate full open and full closed position of the valve.

1.2.2 INDICATOR

Globe valve 75M13138 HCLV-3 has a Bourns Model 156 position indicator mounted on the valve to indicate the interim valve positions. The indicator is furnished with MS 33656-2 pressure fittings for gaseous supply and a 1/2-inch MPT for electrical conduit connection. The indicator is manufactured by Bourns Laboratories, Inc., Riverside, California, is approximately 4-3/4 inches long, and is 1 inch square. The lugs, case and shaft are stainless steel and the resistor is of the Evanohm wire type. Stem travel of the valve stem is 1-1/2 inches and the indicator resistance varies from 0 to 5000 ohms.

1.3 APPLICABLE DOCUMENTS

The following documents contain the test requirements for Globe Valve 75M13138 HCLV-3 and the position indicator.

a. KSC-STD-164(D), Standard Environmental Test Methods for Ground Support Equipment Installations at Cape Kennedy.

b. NASA Drawings 75M15154 and 75M13138 HCLV-3.

c. Cleanliness Standard, MSFC-STD-164.

d. Test Plan CCSD-FO-1045-1R.

e. Test Procedure TP-RE-CCSD-FO-1045-2R.

SECTION II

RECEIVING INSPECTION

2.1 TEST REQUIREMENTS

Each specimen shall be visually and dimensionally inspected for conformance to the applicable specifications prior to testing.

2.2 TEST PROCEDURE

2.2.1 A visiual and dimensional inspection of each of the three specimens was performed to determine compliance with NASA drawing 75M13138 HCLV-3 and the applicable vendor drawings (A4806 and A4951) to the extent possible without disassembly of the test specimens. At the same time the specimens were also inspected for poor workmanship and manufacturing defects.

2.2.2 All pressure gages were removed, and their accuracy was determined. The gages were then reinstalled on the specimens.

2.3 TEST RESULTS

2.3.1 Specimen 1

The specimen complied with NASA drawing 75M13138 HCLV-3 and vendor drawings A-4951 and A-4806. The following evidence of poor workmanship and manufacturing defects were observed and reported in Interim Report GSE 031:

1. Bracket (part number 41110) was bent on the lower section of valve mounting. (See figure 2-1).
2. Misalignment of lock stem (part number 41841) and bracket (part number 41827). (See figure 2-5).
3. Caps on Bourns position indicator were missing and allowed the indicator ports to become plugged with packing material. (See figure 2-5).
4. Shipping containers failed to support and protect the specimen during shipment. (See figure 2-2).
5. The cap screws (part number 25026) were too short and allowed no thread margin. (See figure 2-3).
6. Cap screw 1-FN4 (part number A-4951) stripped off. (See figure 2-4).

2.3.2 Specimen 2

The specimen complied with NASA drawing 75M13138 HCLV-3 and vendor drawings A-4951 and A4806. The following evidence of poor workmanship and manufacturing defects were observed and reported in Interim Report GSE 031:

1. Cap screw, hex head - 5/16 x 18 x 5/8 (part number 12484), missing. **(See figure 2-1).**

2. Nut (part number 41842) missing from Bourns position indicator. **(Photograph not available).**

3. Misalignment of lock stem (part number 41841) and bracket (part number 41827). **(See figure 2-5).**

2.3.3 Specimen 3

The specimen complied with NASA drawing 75M13138 HCLV-3 and vendor drawings A-4951 and A-4806. No evidence of poor workmanship or manufacturing defects was observed.

2.4 TEST DATA

The data presented in tables 2-1, 2-2, and 2-3 were recorded during the inspection of the three specimens.

Table 2-1. Specimen Nomenclature

	Valve			Domotor		Position Indicator		
	Name	Serial No.	Model	Name	S/N	Name	Serial No.	Part No.
Specimen 1	Annin	60609-1-1	1760	Worthington	None	Bourns Laboratories	35-224	2001566206
Specimen 2	Annin	60609-1-2	1760	Worthington	None	Bourns Laborato4ies	13-534	2001566206
Specimen 3	Annin	60609-1-3	1760	Worthington	None	Bourns Laboratories	22-174	2001566206

Table 2-2. Specimen Dimensions

	Inlet Port		Outlet Port		Overall	Vacuum	Bellows	Bourns Cord
	OD	ID	OD	ID	Length	Jacket OD	OD	Length
Specimen 1	1.938	1.767	1.937	1.770	13.5	3.5	2.0	60
Specimen 2	1.938	1.767	1.937	1.770	13.5	3.5	2.0	59¼
Specimen 3	1.938	1.771	1.938	1.769	13.5	3.5	2.0	60

Note: All dimensions are in inches

Table 2-3. Specimen Gage Accuracy

	Signal Pressure Gage (Percent)	Supply Pressure Gage (Percent)	Actuator Pressure Gage (Percent)
Specimen 1	91.0	98.1	98.2
Specimen 2	93.5	98.6	99.1
Specimen 3	90.3	97.1	96.6

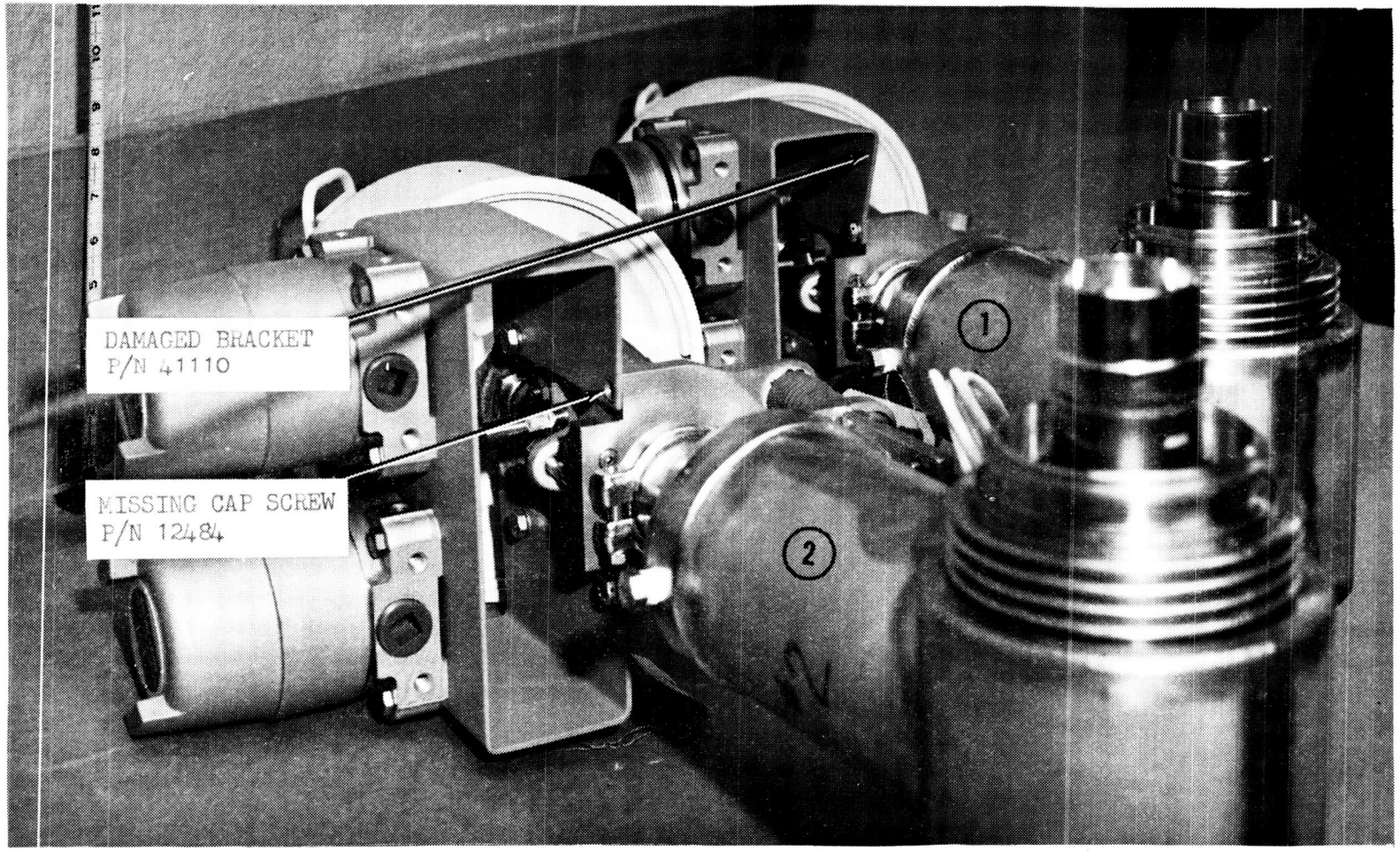


Figure 2-1. Shipping Defects

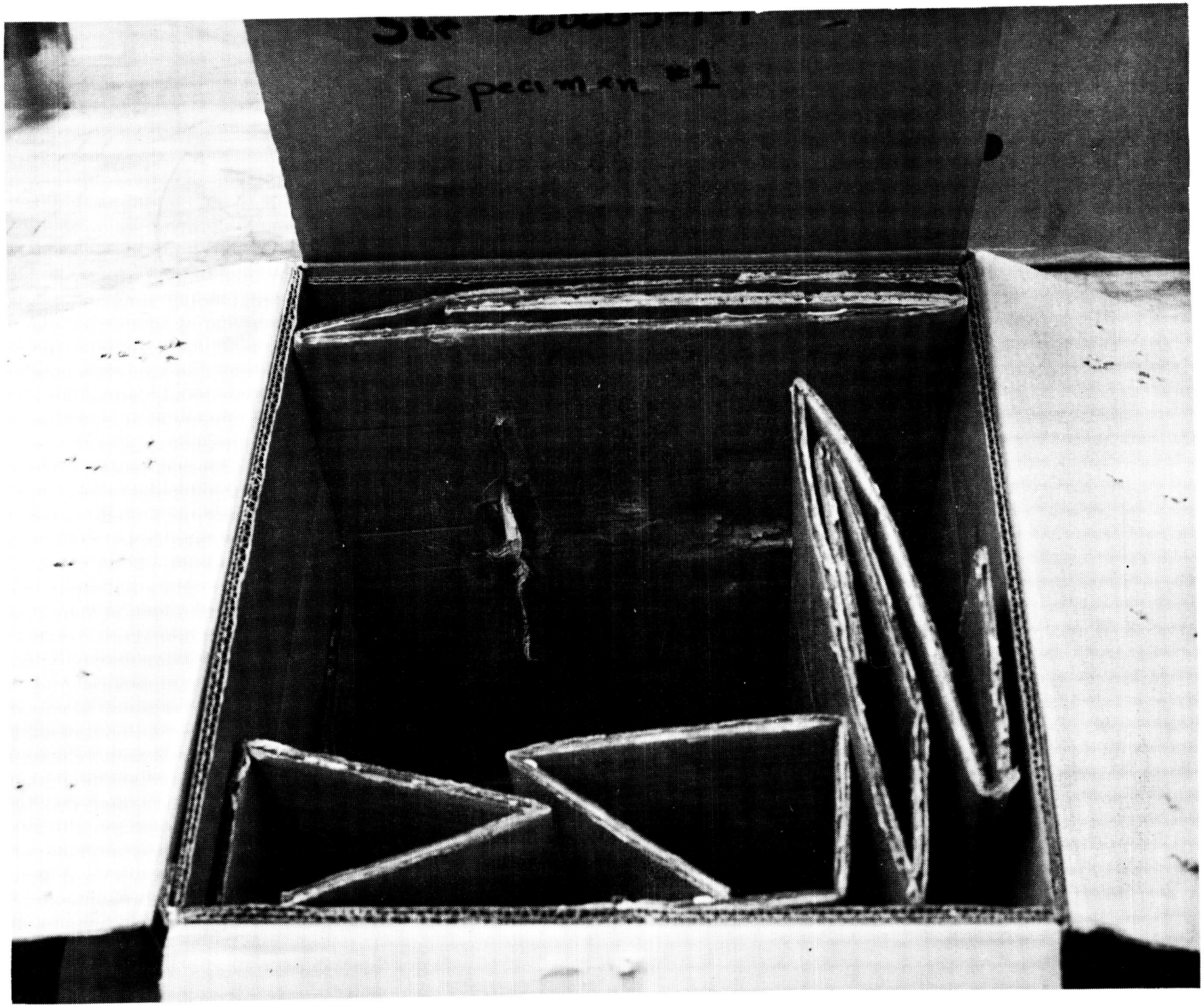


Figure 2-2. Defective Shipping Containers

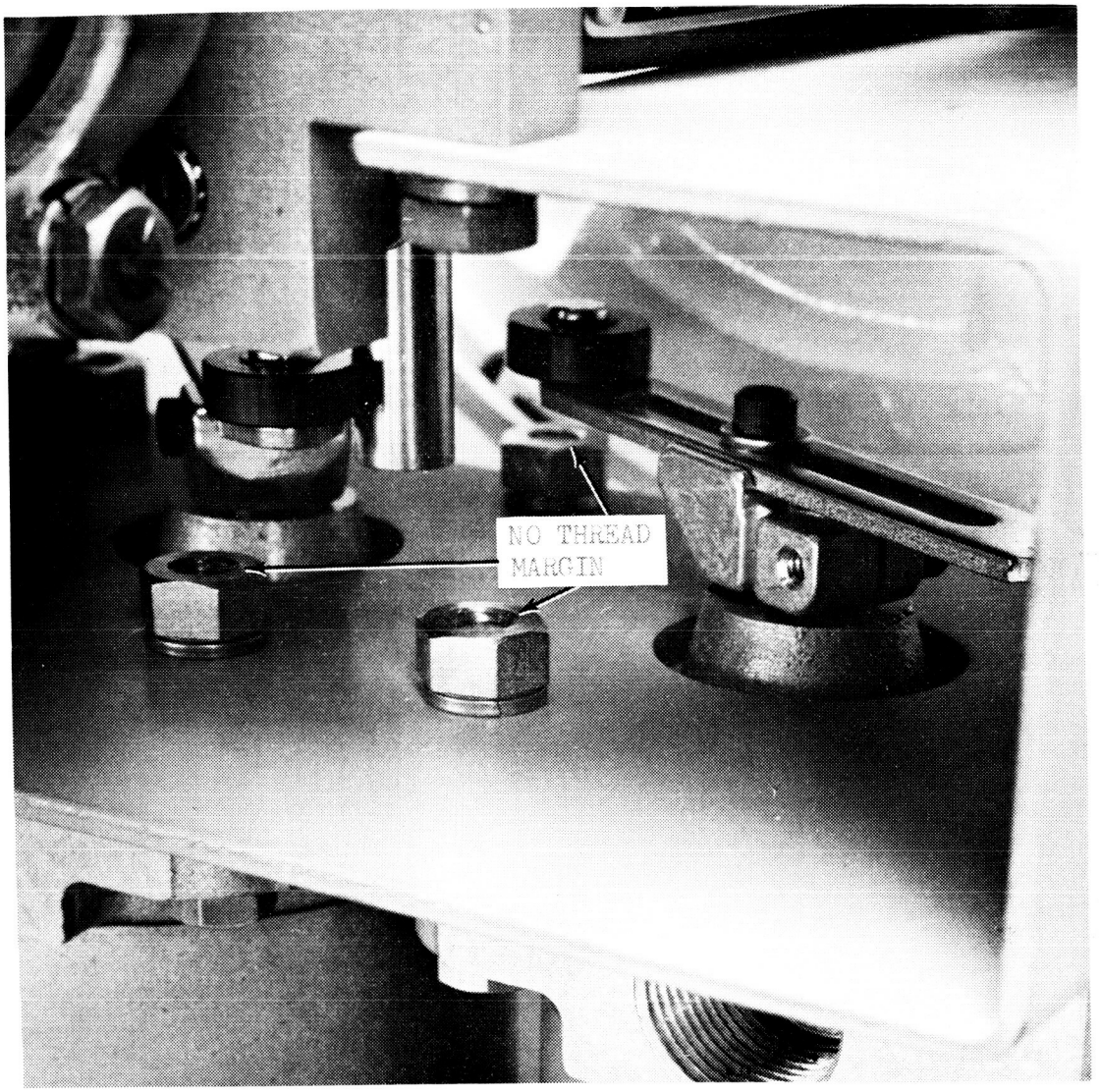


Figure 2-3. Manufacturing Defect

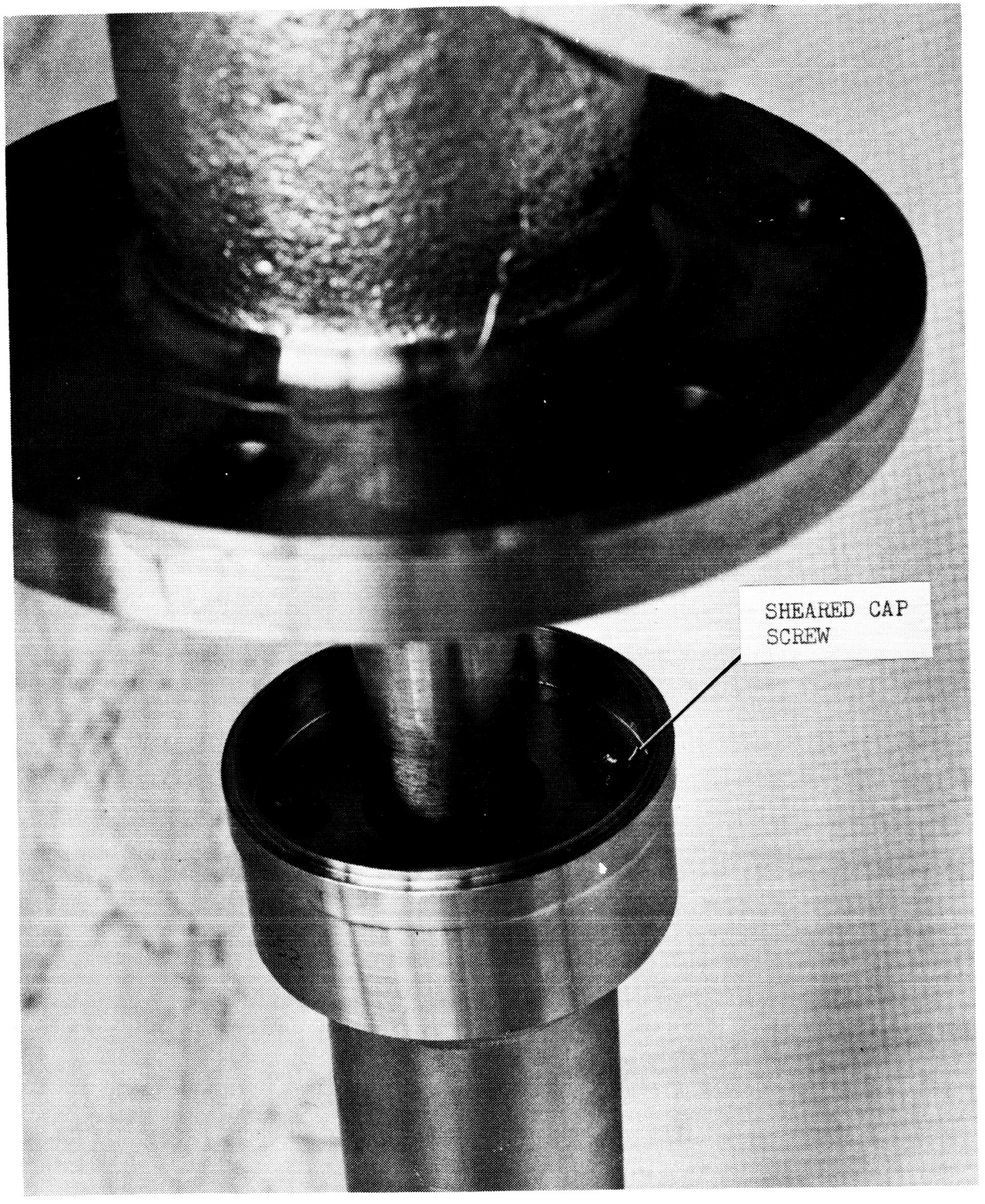


Figure 2-4. Poor Workmanship

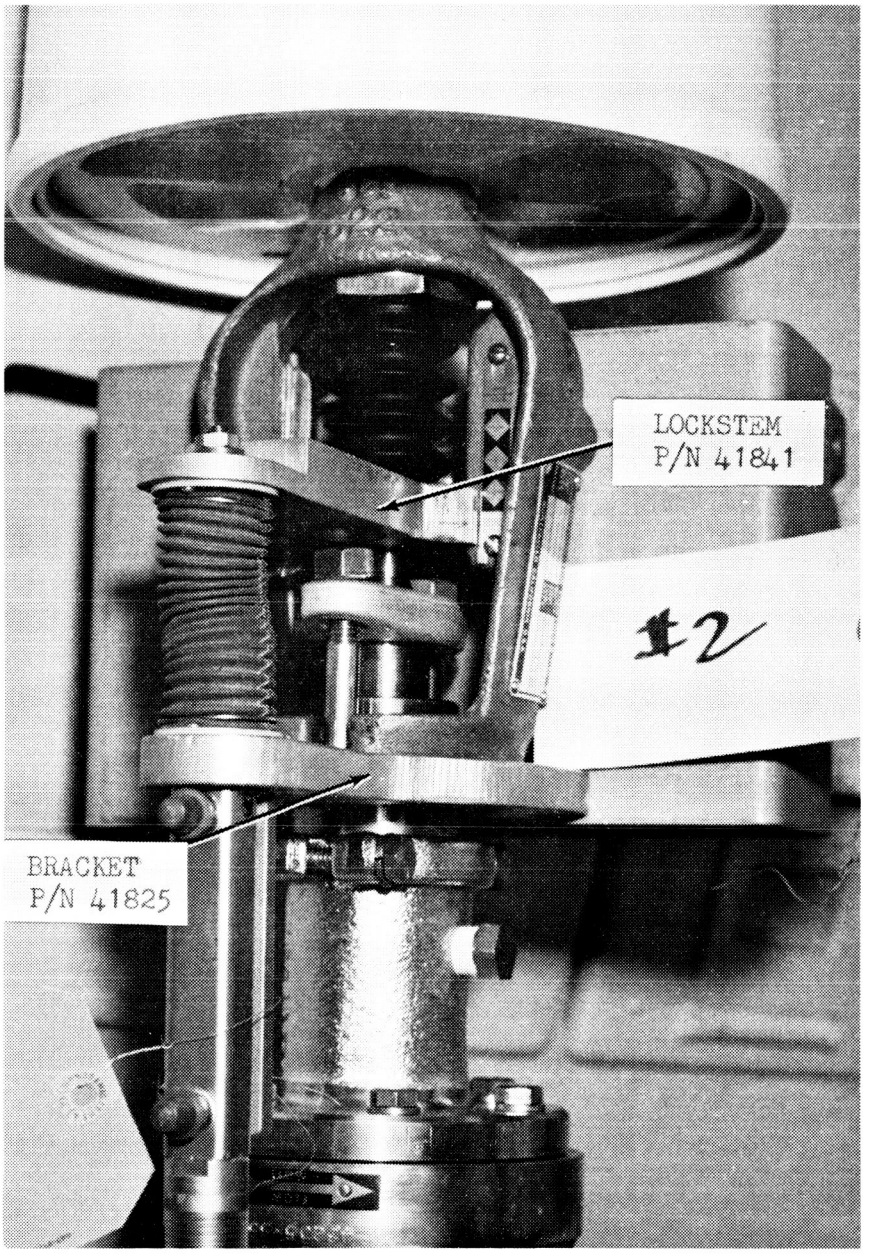
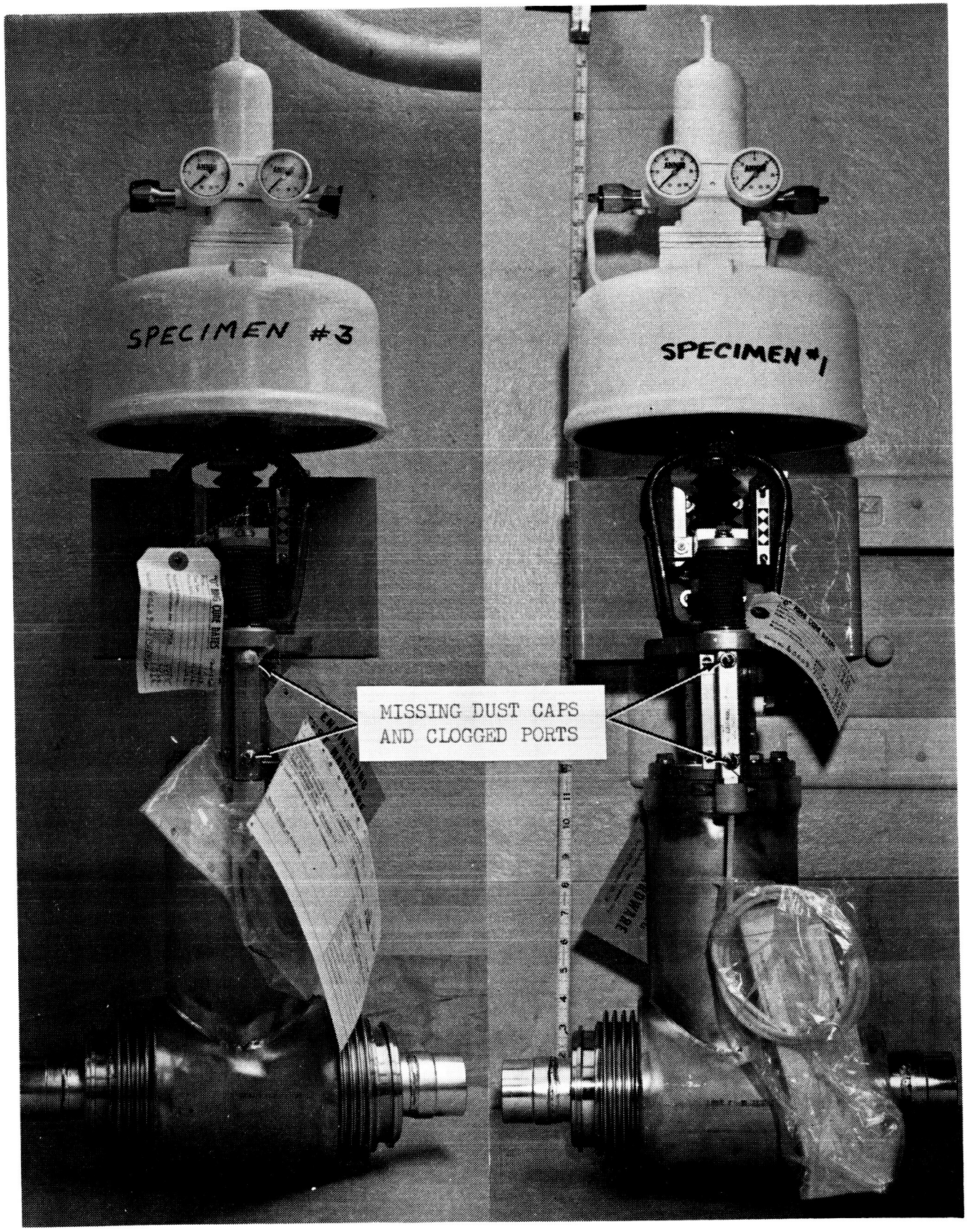


Figure 2-5. Misalignment of Bracket and Lockstem



Figuer 2-6. **Missing Caps and Plugged Indicators**

SECTION III

PROOF PRESSURE TEST

3.1 TEST REQUIREMENTS

3.1.1 The valve body of each specimen shall be pressurized with GN_2 to the proof pressure of 150 psig. This pressure shall be maintained for 5 minutes and the specimen shall be checked for external leakage and distortion.

3.1.2 Each specimen actuator shall be pressurized with GN_2 to the proof pressure of 75 psig. This pressure shall be maintained for 5 minutes and the actuator shall be checked for external leakage and distortion.

3.1.3 Each signal pressure port shall be pressurized with GN_2 to the proof pressure of 22 psig. This pressure shall be maintained for 5 minutes and the specimens domotor shall be checked for external leakage and distortion.

3.1.4 The vacuum jacket shall be pressurized to 20 psig with GN_2. This pressure shall be maintained for 5 minutes and the specimen shall be checked for internal and external leakage.

3.1.5 A standardized helium mass spectrometer shall be connected to the annular space (vacuum jacket) of the valve and the vacuum jacket shall be evacuated to a pressure of 0.05 microns of Hg **absolute.**

3.1.6 **The inner line of the valve shall be pressurized to 100 psig with a He-N_2 mixture containing a minimum of 10 percent He. The outside of the valve shall be enclosed in a plastic bag and the bag shall be purged with He. The mass spectrometer shall be observed for leakage into the annular space of the valve. For acceptance of the valve the leakage shall be less than 1×10^{-7} atm cc/sec.**

3.2 TEST PROCEDURE

3.2.1 The test specimen was installed as shown in figure 3-1 using the equipment listed in table 3-1. It was determined that all connections were tight, gages were installed and operating properly, and all valves were closed.

3.2.2 Hand valve 3 was opened and a pressure of 2200 psig was observed on gage 5.

3.2.3 Hand valves 10 and 15 were opened and regulator 6 was adjusted until a pressure of 50 psig was observed on gage 8. Hand valve 15 was closed and regulator 6 was readjusted until a pressure of 15 psig was indicated on gage 8.

3.2.4 Hand valve 14 was opened and 15 psig opening pressure was routed to the specimen actuator signal port.

3.2.5 After the specimen reached the fully open position, hand valve 14 was closed.

3.2.6 Hand valve 13 was opened and regulator 6 was readjusted until gage 8 indicated 150 psig.

3.2.7 Hand valve 10 was closed and the specimen pressure was maintained for 5 minutes. During this period, regulator 6 was readjusted to 50 psig and hand valve 23 was opened. Gage 8 was monitored for leakage in the valve.

3.2.8 The system was bled to zero psig by opening hand valve 9, 10, 14, and 15, and closing regulator 6 to zero outlet pressure.

3.2.9 Hand valves 9, 13, 14, and 23 were closed and regulator 6 was adjusted to slowly pressurize the specimen actuator to 75 psig. This pressure was monitored on gage 8.

3.2.10 The pressure on the actuator was maintained for 5 minutes. Gage 8 was monitored.

3.2.11 Hand valve 9 was opened, regulator 6 was closed to zero outlet pressure, and the system was bled to zero psig as indicated on gage 8.

3.2.12 Hand valves 9 and 15 were closed, hand valve 14 was opened and regulator 6 was adjusted to slowly pressurize the actuator signal port to 22 psig. This pressure was monitored on gage 8.

3.2.13 Hand valve 10 was closed and gage 8 was monitored for 5 minutes for indications of leakage from the actuator signal port.

3.2.14 Hand valves 9 and 10 were opened, regulator 6 was closed to zero outlet pressure, and the system was bled to zero psig.

3.2.15 The specimen was removed from the installation and installed as shown in figure 3-2 using the equipment listed in table 3-1. All connections were tight, all gages were installed and operating properly, and all hand valves and regulator 6 were closed.

3.2.16 Hand valve 3 was opened and the 1800 psig supply pressure was monitored on gage 5.

3.2.17 Hand valve 10 was opened and regulator 6 was adjusted until a pressure of 20 psig was indicated on gage 8.

3.2.18 Hand valve 10 was closed and the vacuum jacket was checked for leakage for 5 minutes by monitoring gage 8.

3.2.19 The system was bled to zero psig by closing regulator 6 to zero outlet pressure and opening hand valves 9 and 10.

3.2.20 The specimen was removed from the installation and installed as shown in figure 3-3 using the equipment listed in table 3-1. All connections were tight, all gages were installed and working properly, and all hand valves, except hand valve 21, were closed. Regulators 6 and 17 were adjusted to zero outlet pressure.

3.2.21 Hand valve 3 was opened and the 1800 psig supply pressure was monitored on gage 5.

3.2.22 Regulator 6 was adjusted until gage 8 indicated 100 psig pressure in the interior of the specimen.

3.2.23 Hand valve 13 was opened and the 1800 psig, pure helium supply pressure was monitored on gage 16.

3.2.24 Regulator 17 was adjusted to provide a low pressure, continuous He purge of plastic bag 22.

3.2.25 The vacuum jacket was evacuated to 1×10^{-7} microns by operating the vacuum pump on helium mass spectrometer 20. This pump continued operation throughout the remainder of the test.

3.2.26 The vacuum jacekt was monitored for leakage for 5 minutes by observing the indicator of helium mass spectrometer 20. The low pressure purge and 100 psig internal pressure at the specimen were maintained throughout this period.

3.2.27 The system was vented to zero psig by closing regulators 6 and 17 and opening hand valves 9 and 14.

3.2.28 The specimen was removed from the installation and inspected.

3.3 TEST RESULTS

The specimen did not leak during any of the tests and there was no evidence of distortion.

3.4 TEST DATA

The data presented in table 3-2 were recorded during the test.

Table 3-1. Proof Pressure Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Specimen	Annin Company	1760	60609-1-1	Globe valve, ½-inch, 100-psig
2	Pressure Source	Air Products	NA	NA	0-to 2200-psig GN_2
3	Hand Valve	Air Products	3550		½-inch
4	Filter	Linde	NA	NA	10 micron; part of regulator 6
5	Pressure Gage	Linde	27Y56	NA	0-to 3500-psig
6	Regulator	Linde	8956	NA	0-to 3500-psig - inlet 0-to 2500-psig - outlet
7	Pressure Gage	Linde	26Y23	NA	0-to 2500-psig
8	Pressure Gage	Heise	NASA 0813	C14226	0-to 160-psig 0.1% FS Cal date 8-20-66
9	Hand Valve	Robbins Aviation, Inc.	SSKG-250-4T	NA	¼-inch
10	Hand Valve	Robbins Aviation, Inc.	SSKG-250-4T	NA	¼-inch
11	Pressure Source	Air Products	NA	NA	0-to 1800-psig He
12	Cap		NA	NA	¼-inch, AN
13	Hand Valve	Robbins Aviation, Inc.	SSKG-250-4T	NA	¼-inch
14	Hand Valve	Robbins Aviation, Inc.	SSKG-250-4T	NA	¼-inch
15	Hand Valve	Robbins Aviation, Inc.	SSKG-250-4T	NA	¼-inch
16	Pressure Gage	Linde	27Y56	NA	0-to 3500-psig
17	Regulator	Linde	8956	NA	0-to 3500-psig inlet 0-to 2500-psig outlet
18	Pressure Gage	Linde	26Y23	NA	0-to 2500-psig Cal date
19	Pressure Source	Air Products	NA	NA	0-to 1800-psig 90% N_2 -10% He
20	Helium Mass Spectrometer	Veeco	MS-9AB	08-113 012470	Cal date 8-10-66
21	Vacuum Valve	Cryolab	V01-84-1Z2	NA	½-inch
22	Plastic Bag		NA	NA	
23	Hand Valve	Robbins Aviation, Inc.	NA	NA	¼-inch

Table 3-2. Proof Pressure Test Data

Specimen	Paragraph Number	Test Object	Media	Pressure (psig)	Time (min)	Leakage
1	3.1.1	Valve	GN_2	150	5	None
1	3.1.2	Actuator	GN_2	75	5	None
1	3.1.3	Domotor	GN_2	22	5	None
1	3.1.4	Vacuum Jacket	GN_2	20	5	None
1	3.1.6	Valve Vacuum Jacket	90% GN_2 10% He	100 psig .05 microns	NA	None *
2	3.1.1	Valve	GN_2	150	5	None
2	3.1.2	Actuator	GN_2	75	5	None
2	3.1.3	Domotor	GN_2	22	5	None
2	3.1.4	Vacuum Jacket	GN_2	20	5	None
2	3.1.6	Valve Vacuum Jacket	90% GN_2 10% He	100 psig .05 microns	NA	None *
3	3.1.1	Valve	GN_2	150	5	None
3	3.1.2	Actuator	GN_2	75	5	None
3	3.1.3	Domotor	GN_2	22	5	None
3	3.1.4	Vacuum Jacket	GN_2	20	5	None
3	3.1.6	Valve Vacuum Jacket	90% GN_2 10% He	100 psig .05 microns	NA	None *

* Minimum reading 6.4×10^{-10} scc/sec $\pm 10\%$.

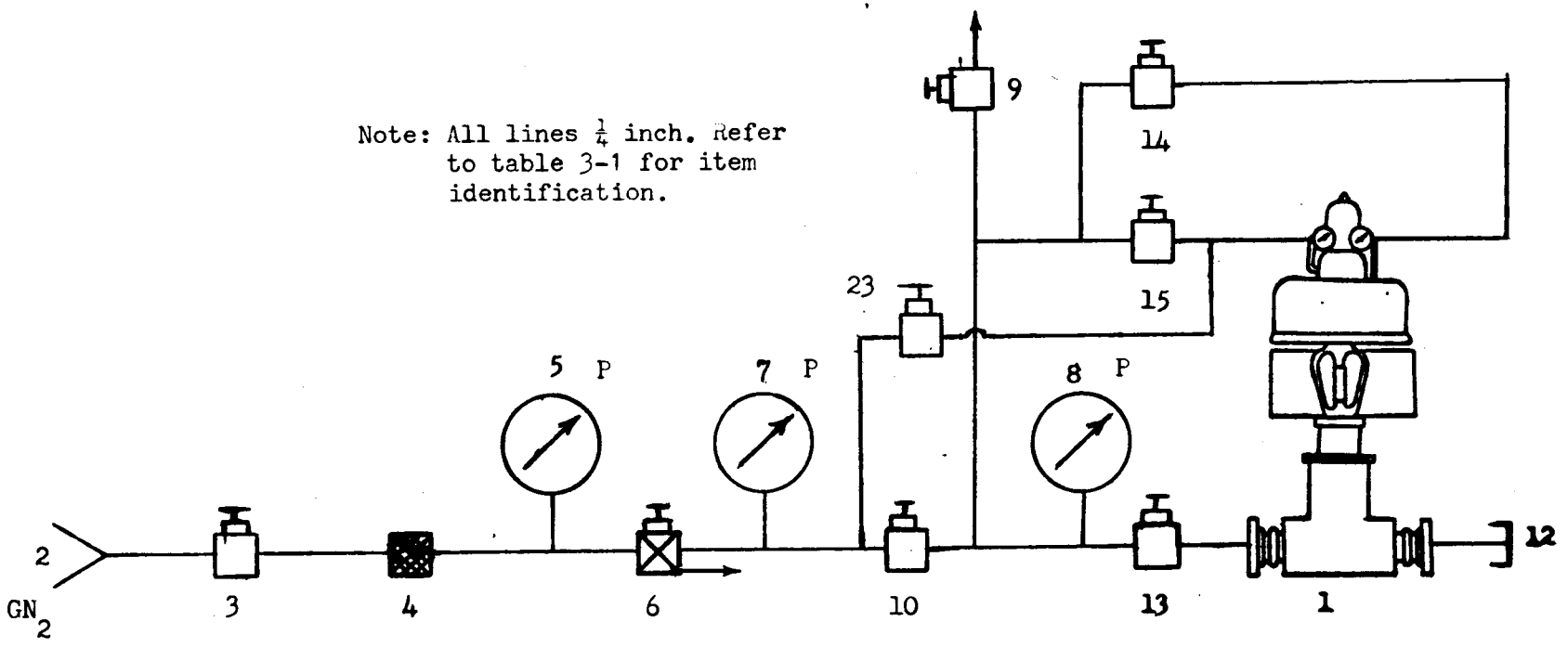


Figure 3-1 Proof Pressure Test Schematic (Valve and Domotor)

Note: All lines $\frac{1}{4}$ inch.
Refer to table 3-1 for item identification.

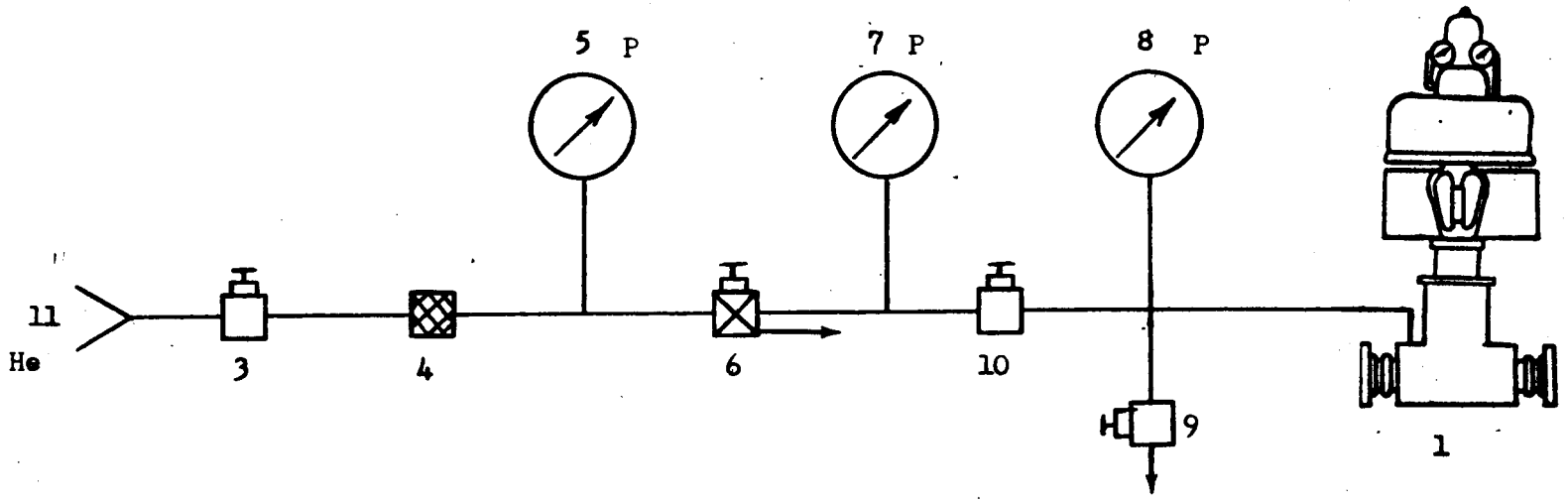


Figure 3-2. Proof Pressure Test Schematic (Vacuum Jacket)

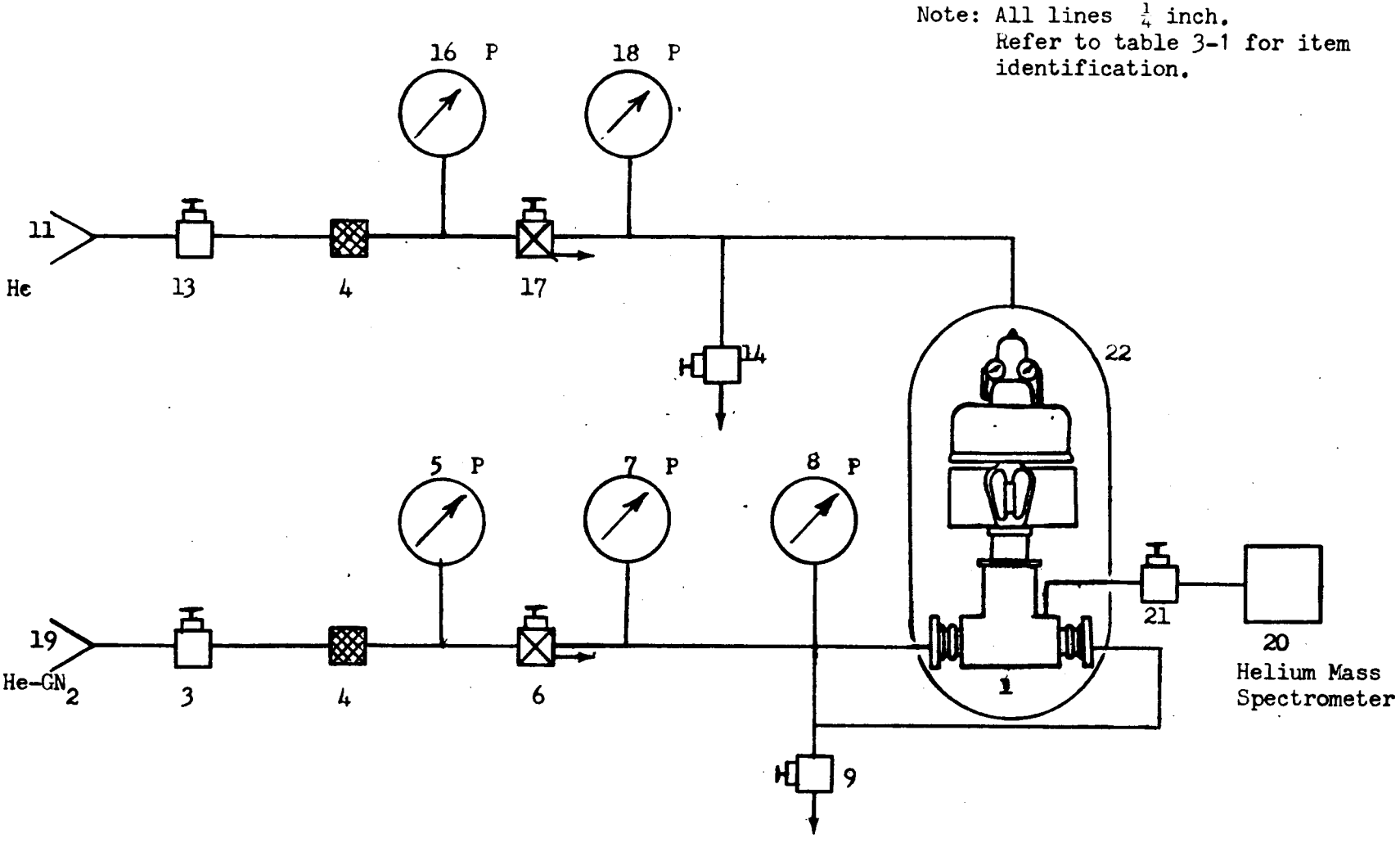


Figure 3-3. Vacuum Leak Test Schematic

SECTION IV

FUNCTIONAL TEST

4.1 TEST REQUIREMENTS

4.1.1 GENERAL

4.1.1.1 Position Indicating Switches. The position indicating switches shall be monitored during each step of the functional test.

4.1.1.2 Vacuum Jacket. During all phases of the functional test, the vacuum jacket shall be evacuated to less than 10 microns of mercury absolute and monitored for pressure rise and temperature drop.

4.1.1.3 External Leakage. The specimen shall be checked for external leakage during the functional test.

4.1.2 CYCLING

The specimen shall be pneumatically cycled by the actuator with GN_2 from the closed to the open to the closed position 10 times. This shall be done during the initial functional test only.

4.1.3 VALVE INTERNAL SEAT LEAKAGE

4.1.3.1 **The specimen shall be held in the closed position by pressurizing the actuator with 20 psig GN_2 and the upstream side of the specimen with 100-psig He or GH_2 at -423°F. The valve seat shall be checked for leakage for 5 minutes. Maximum allowable leakage is 15 sccm.**

4.1.3.2 **The procedures described in 4.1.3.1 shall be repeated, except that the pressure shall be applied to the downstream side with 25-psig He or GH_2 at -423°F.**

4.1.4 LOSS OF ACTUATOR PRESSURE

Procedures described in 4.1.3.1 and 4.1.3.2 shall be repeated, except that no pressure shall be applied to the actuator signal or supply ports.

4.1.5 INTERNAL SEAT LEAKAGE

Procedures described in 4.1.3.1 and 4.1.3.2 shall be repeated, except that the actuator supply pressure shall be 50 psig.

4.1.6 ACTUATOR SIGNAL

The specimen shall be pressurized to 100 psig using LH_2 as the pressure medium. The actuator supply shall be pressurized to 50 psig using GN_2 as the pressure medium. The actuator signal port shall be pressurized with GN_2 and the pressure varied from 3 to 15 psig to open the valve 25, 50, 75, and 100 per cent. The specimen shall be closed by reducing the signal pressure from 15 psig to 3 psig, and the time required to close shall be recorded. The specimen shall be opened by applying 15 psig to the actuator signal, and the opening time shall be recorded.

4.1.7 ACTUATOR SIGNAL

Procedures described in 4.1.6 shall be repeated, except that the actuator supply pressure shall be 20 psig.

4.2 TEST PROCEDURE

4.2.1 GENERAL

4.2.1.1 The position indicating switches and the Bourns position indicators were monitored throughout the functional test on recording oscillograph 38.

4.2.1.2 The vacuum jacket was monitored during the functional test by observing vacuum thermocouple 34 and skin thermometer 33.

4.2.1.3 A leak detection solution was used to check the external surface and valve stem of the specimens for leakage during all phases of the functional test.

4.2.1.4 A continuous 5-psig, GN_2 purge was placed on the Bourns position indicator throughout the functional test.

4.2.2. CYCLING

4.2.2.1 The specimen was installed as shown in figures 4-1A and 4-2, using the equipment listed in table 4-1. It was determined all connections were tight, all gages were installed and operating properly, and that all valves were closed.

4.2.2.2 Valve 3 was opened and a pressure of 3000 psig was observed on gages 4, 5, and 6.

4.2.2.3 Regulator 7 was adjusted until a pressure of 15 psig was observed on gage 26.

4.2.2.4 Regulator 8 was adjusted until a pressure of 25 psig was observed on gage 27.

4.2.2.5 Regulator 9 was adjusted until a pressure of 100 psig was observed on gage 28.

4.2.2.6 **Valve 39 was opened and the specimen was allowed to come to the fully opened position. Valve 39 was then moved to the vent position and the specimen was allowed to close. This procedure was performed 10 times, and the resistance of the Bourns indicator was measured. All data were recorded.**

4.2.3 UPSTREAM PRESSURIZATION

4.2.3.1 Valves 13 and 14 were opened and the LH_2 vent stack was purged with GN_2.

4.2.3.2 Valves 13 and 14 were closed.

4.2.3.3 The pressure in LH_2 dewar container 42 was reduced to 50 psig. This pressure was monitored on gage 20. Control of the pressure venting was achieved by opening hand valve 18, venting dewar container 42 through the vent stack, and then closing hand valve 18.

4.2.3.4 LH_2 dewar container 42 was repressurized to 100 psig by opening valves 24 and 19 and adjusting regulator 23.

4.2.3.5 Valves 13, 14, 15, 17, and 39, and back pressure regulator 38 were opened, and the system was purged with GN_2. Back pressure regulator 38, and valves 17, 15, 13, and 14 were closed in that order, and 100-psig GN_2 was trapped in the system. The system was checked for leakage by monitoring pressure transducers 30 and 31.

4.2.3.6 Valve 17 was opened, the pressure was bled to 15 psig, and valve 17 was closed. Valve 16 was opened momentarily and hydrogen was introduced into the system. A leak check was performed.

4.2.3.7 Valves 16 and 17 were opened and hydrogen was flowed through the system until thermometer 32 indicated a temperature of -423°F. When the proper temperature was obtained, valve 39 was moved to the vent position and the specimen closed.

4.2.3.8 Venting regulator 49 was adjusted at 2.9 psig as indicated on gage 29.

4.2.3.9 Leak detector 41 was installed as shown in figure 4-1B and valve 17 was closed.

4.2.4 VALVE INTERNAL SEAT LEAKAGE TEST

4.2.4.1 Regulator 8 was adjusted until an actuator pressure of 20 psig was observed on gage 27.

4.2.4.2 Venting regulator 49 was adjusted until a signal pressure of 29 psig (+0.0, -0.1 psig) was observed on gage 29.

4.2.4.3 A 5 minute leak check of the specimen was performed by measuring displacement of fluid. All data was recorded.

4.2.5 LOSS OF ACTUATOR PRESSURE TEST

The procedures described in 4.2.3.7 through 4.2.4.3 was repeated except a signal pressure and actuator pressure of zero psig were used.

4.2.6 INTERNAL SEAT LEAKAGE TEST

The test described in paragraphs 4.2.3.7 through 4.2.4.3. was repeated except an actuator pressure of 50 psig was used.

4.2.7 ACTUATOR SIGNAL PRESSURE TEST

Back pressure regulator 38 was adjusted to 20 psi below dewar container pressure.

4.2.7.1 Valve 16 was opened and valve 39 was adjusted until the mechanical travel scale of the specimen indicated the specimen was $\frac{1}{4}$ open. All data were recorded.

4.2.7.2 The procedure described in 4.2.7.1 was repeated for valve positions of 1/2, 3/4, and fully open.

4.2.7.3 Valve 39 was moved to the vent position, then to the open position, and back to the vent position. The time required to open and close the specimen was recorded.

4.2.7.4 Regulator 8 was adjusted until a pressuee of 20 psig was observed. on gage 27.

4.2.7.5 The procedures described in 4.2.7.1 through 4.2.7.3 were repeated.

4.2.8 SYSTEM PURGE

4.2.8.1 Valve 16 was closed, and back pressure regulator 38 and valves 17 and 39 were opened.

4.2.8.2 Valves 13 and 15 were opened and the system was purged with GN_2.

4.2.8.3 Valves 13, 15, and 17 were closed, back pressure regulator 38 was placed in the operating position, and valve 39 was placed in the vent position.

4.2.9 DOWNSTREAM PRESSURIZATION

4.2.9.1 The specimen was removed from the installation, turned 180 degrees, and reinstalled as shown in figure 4-1A.

4.2.9.2 The upstream pressurization procedure, paragraph 4.2.3, was repeated except LH_2 dewar container 42 was depressurized to 15 psig, and then repressurized with He to 25 psig.

4.2.10 DOWNSTREAM LEAKAGE TESTS

4.2.10.1 The tests described in paragraphs 4.2.4, 4.2.5, and 4.2.6 were repeated.

4.2.11 The purge described in paragraph 4.2.8 was performed.

4.3 TEST RESULTS

4.3.1 **SPECIMEN 1**

4.3.1.1 The specimen successfully met the functional test requirements when the actuator was pressurized to 50 psig.

4.3.1.2 **The specimen failed to operate with the upstream side pressurized to 100 psig with GH_2 at -418°F and the actuator pressurized to 20 psig.**

4.3.1.3 The specimen failed to seat with the downstream side pressurized to 25 psig with GH_2 at -418°F and the actuator pressurized to 20 psig. The specimen cracked at 2.8 psig signal pressure and did not seat until the signal pressure was lowered to 2.5 psig.

4.3.2 **SPECIMEN 2**

The specimen successfully completed the functional test requirements.

4.3.3 **SPECIMEN 3**

The specimen failed to meet the functional test requirements. The specimen cracked at 2.7 psig signal pressure and seated at 2.6 psig signal pressure.

4.3.3.1 A second function test was conducted using a minimum actuator pressure of 25 psig and a minimum signal pressure of 2.7 psig. The specimen successfully completed the functional test requirements.

4.4 TEST DATA

The data recorded during the functional test are shown in tables 4-3 through 4-5.

Table 4-1. Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Specimen	Annin Company	1760	NA	Globe valve, ½-inch, 100-psig
2	Pressure Source		NA	NA	3000-psig GN_2
3	Hand Valve	Hoke	PY273	NA	½-inch
4	Pressure Gage	Union Carbide	79172-1	NA	0-to 100-psig
5	Pressure Gage	Union Carbide	29172-1	NA	0-to 100-psig
6	Pressure Gage	Union Carbide	29177-1	NA	0-to 100 psig
7	Pressure Regulator	Victor	SR431	859279	0-to 50-psig
8	Pressure Regulator	Victor	SR431	859273	0-to 150-psig
9	Pressure Regulator	Victor	SR431	859203	0-to 150-psig
10	Pressure Gage	Victor	22660-1	NA	0-to 4000-psig
11	Pressure Gage	Union Carbide	29177-1	NA	0-to 400-psig
12	Pressure Gage	Victor	22660-1	NA	0-to 4000-psig
13	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
14	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
15	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
16	Pneumatic Valve	Hoke	DR294AJ	NA	¼-inch
17	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
18	Hand Valve	Control Components	304-SS	NA	¼-inch
19	Hand Valve	Powell	NA	8157	
20	Pressure Gage	US Gauge Company	10895	NA	0-to 30-VAC 0-to 300-psig ±0.5% FS Cal date 10-7-66
21	Pressure Gage	Supergauge	-B-	106-1121-13	0-to 160-psig ±0.5% FS
22	Pressure Gage	Victor	30-205-202	NA	0-to 4000-psig
23	Pressure Regulator	Victor	701N	8699S4	0-to 250-psig
24	Hand Valve	Airco	NA	NA	
25	Pressure Source	Airco Helium Bottle	NA	NA	1800-psig He
26	Pressure Gage	Duragauge	-B-		0-to 30-psig ±0.5% FS Cal date 10-7-66
27	Pressure Gage	Heise	-B-	95-1398B	0-to 160-psig ± 0.1 % FS Cal date 10-7-66
28	Pressure Gage	Supergauge	-B-	106-1119B	0-to 160-psig ± 0.5 % FS Cal date 10-7-66
29	Pressure Gage	Heise	-B-	95-1376B	0-to 60-psig Cal date 10-7-66

Table 4-1. Functional Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
30	Pressure Transducer	CEC	NA	NA	0-to 100-psig ± 0.5% FS Cal date 10-7-66
31	Pressure Transducer	CEC	NA	018170	0-to 100-psig ± 0.5% FS Cal date 10-7-66
32	Resistance Thermometer	Rosemount	150MA32	6454	-415 to -430 ± 0.5°F
33	Thermocouple	Copper - Co Constantan	NA	NA	±1°F
34	Vacuum Thermo-couple	NRC Equipment Corporation	Type 0521	NA	±10% accuracy Cal date 9-15-66
35	Vacuum Valve	Cryolab	SV1 84-SW-2	NA	½-inch
36	Vacuum Pump	Welch	010587	9363-97	
37	Check Valve	Lukenheiman	2144	NA	2-inch, vertical
38	Back Pressure Regulator	Fisher	NA	4140132	1-inch
39	Hand Valve	Republic Mfg.	NA	424	¼-inch
40	Recording Oscillograph	CEC	NA	012592	Cal date 6-27-67
41	Leak Detector	CCSD	NA	NA	
42	175 Liter Dewar Container	Cryenco	195-L	1158-19	LH_2
43	Hand Valve	Robbins	SSKG250	NA	6000 psi
44	Hand Valve	Robbins	SSKG250	NA	6000 psi
45	Hand Valve	Robbins	SSKG250	NA	6000 psi
46	Hand Valve	Robbins	SSKG250	NA	6000 psi
47	Solenoid Valve	Marotta	MV74	NA	3000 psig
48	Timer	Wilson	Mod.#1	NA	Repeat cycle timer
49	Venting Regulator	Tescom	26-1610 -43-031	2505	0-to 100-psig
50	Environmental Chamber	CCSD	NA	NA	-20 to +200°F

Table 4-2. Initial Functional Test Data

TEST DATA SHEET — Specimen No. 1

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Int Seat	GH_2	-418	78	23	100	0	20	2.9	0	0			0 1/4 1/2 3/4 Full	Valve failed to repsond *			
	Loss of Psi	GH_2	-418	78	23	100	0	0	0	0	0							
	Int Seal	GN_2	-418	78	23	100	0	50	2.9	0	0	OK	OK	0 1/4 1/2 3/4 Full	4961 7	2.9 5.7 8.8 11.4 15.0	4.3	4.5
DOWN STREAM	Int Seat	GH_2	-418	78			25	20	2.5 psig 2.8 psig	valve cracked valve 1/8	open							

* Interim report number GSE 64

Table 4-3. Initial Functional Test Data

TEST DATA SHEET — Specimen No. 2

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Int Seat	GH_2	-418	69.1	10	100	0	20	2.9	6.8	0	ok	ok	0	4769	2.9	12.9	6.0
														1/4		6.0		
														1/2		9.3		
														3/4	62	11.5		
														Full	62	15.0		
	Loss of Psi	GH_2	-418	61	10	100	0	0	0	3.0	0	ok	ok					
	Int Seat	GH_2	-418	69.1	10	100	0	50	2.9	0	0	ok	ok	0	4769	2.9	3.4	6.6
														1/4		5.0		
														1/2		8.5		
														3/4		11.2		
														Full	62	15.0		
DOWNSTREAM	Int Seat	GH_2	-418	82	10	0	25	20	2.9	6.8			ok					
	Loss of Psi	GH_2	-418	81	10	0	25	0	0	5.0			ok					
	Int Seat	GH_2	-418	82.4	10	0	25	50	2.9	10.2			ok					

Table 4-4. Initial Functional Test Data

TEST DATA SHEET — Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Int Seat Leakage	GH_2	-418	73	15	100	0	20	2.9 2.6	Valve cracked 0	0		ok	0 1/4 1/2 3/4 Full	4810 217	Did not run		
	Loss of Pressure	GH_2	-418	73	15	100	0	0	0	58	0		ok					
	Int Seat Leakage	GH_2	-418	73	15	100	0	50	2.9 2.6	Valve cracked 0	0	ok		0 1/4 1/2 3/4 Full	4810 217	Did not run		
DOWNSTREAM	Int Seat Leakage	GH_2	-418	73	15	0	25	20	2.9	0	0							
	Loss of Psi	GH_2	-418	73	15	0	25	0	0	0	0							
	Int Seat Leakage	GH_2	-418	73	15	0	25	50	2.9 2.6	* 0	0 0							

* Valve cracked at 2.6 psig pressure, see Interim Report number GSE 69.

Table 4-5. Initial Functional Test Data

TEST DATA SHEET — Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Int Seat Leakage	GH_2	-420	70	7	100	0	25	2.7	0	0	ok	ok	0	4810			
														1/4		5.9		
														1/2		9.2	20.3	5.4
														3/4		12.3		
														Full	215	15.0		
	Loss of Psi	GH_2	-420	70	7	100	0	0	0	0	0		ok					
	Int Seat Leakage	LH_2	-420	68	7	100	0	50	2.7	0	0	ok	ok	0	4810			
														1/4		5.9		
														1/2		8.8	6.0	5.7
														3/4		11.8		
														Full	215	15.1		
DOWN STREAM	Int Seat Leakage	LH_2	-420	68	7	0	25	25	2.7	0	0		ok					
	Loss of Psi	LH_2	-420	68	7	0	25	0	0	0	0		ok					
	Int Seat Leakage	LH_2	-420	68	7	0	25	50	2.7	0	0		ok					

Note: All lines $\frac{1}{4}$ inch unless otherwise indicated.
Refer to table 4-1 for item identification.

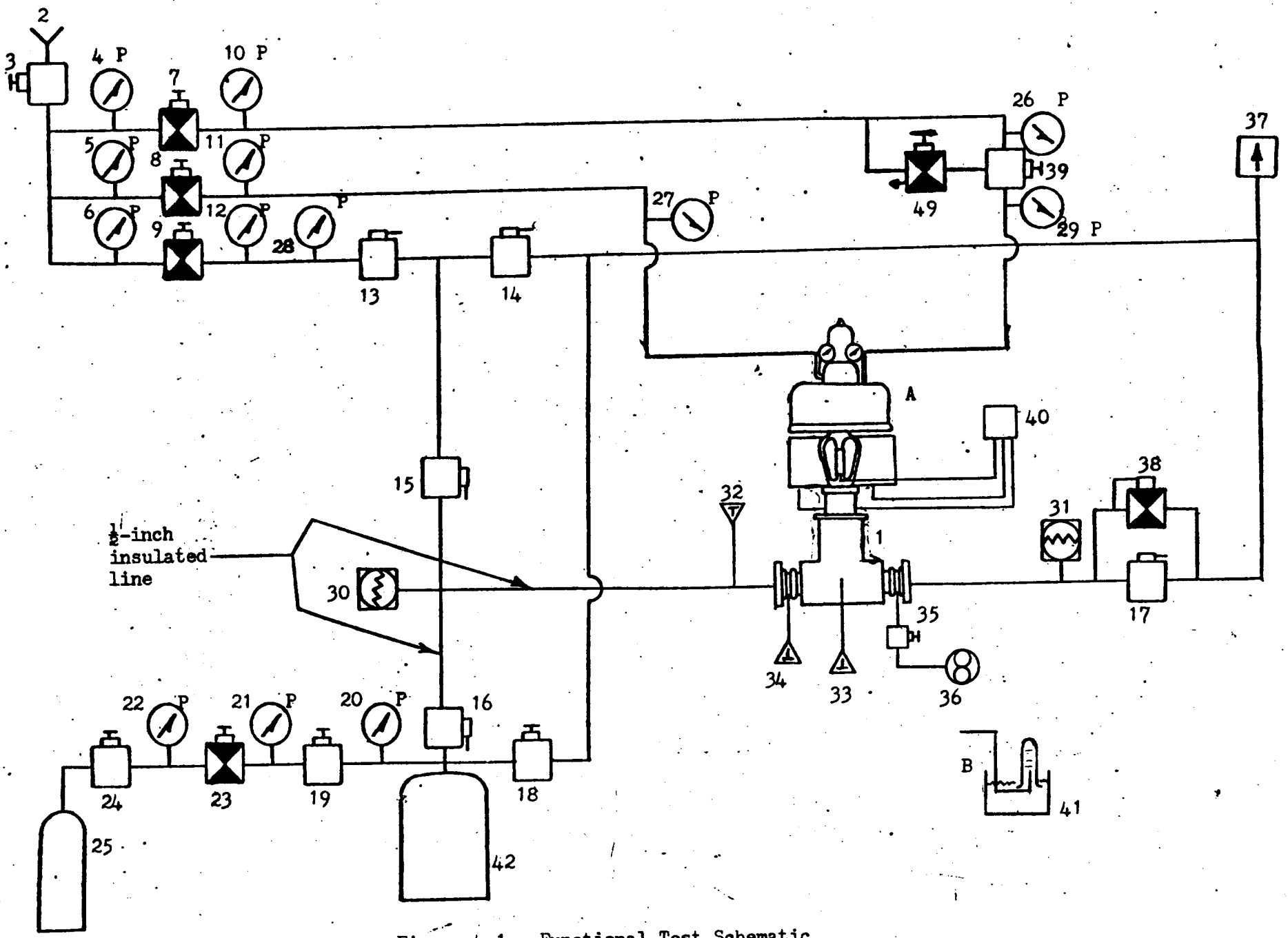


Figure 4-1. Functional Test Schematic

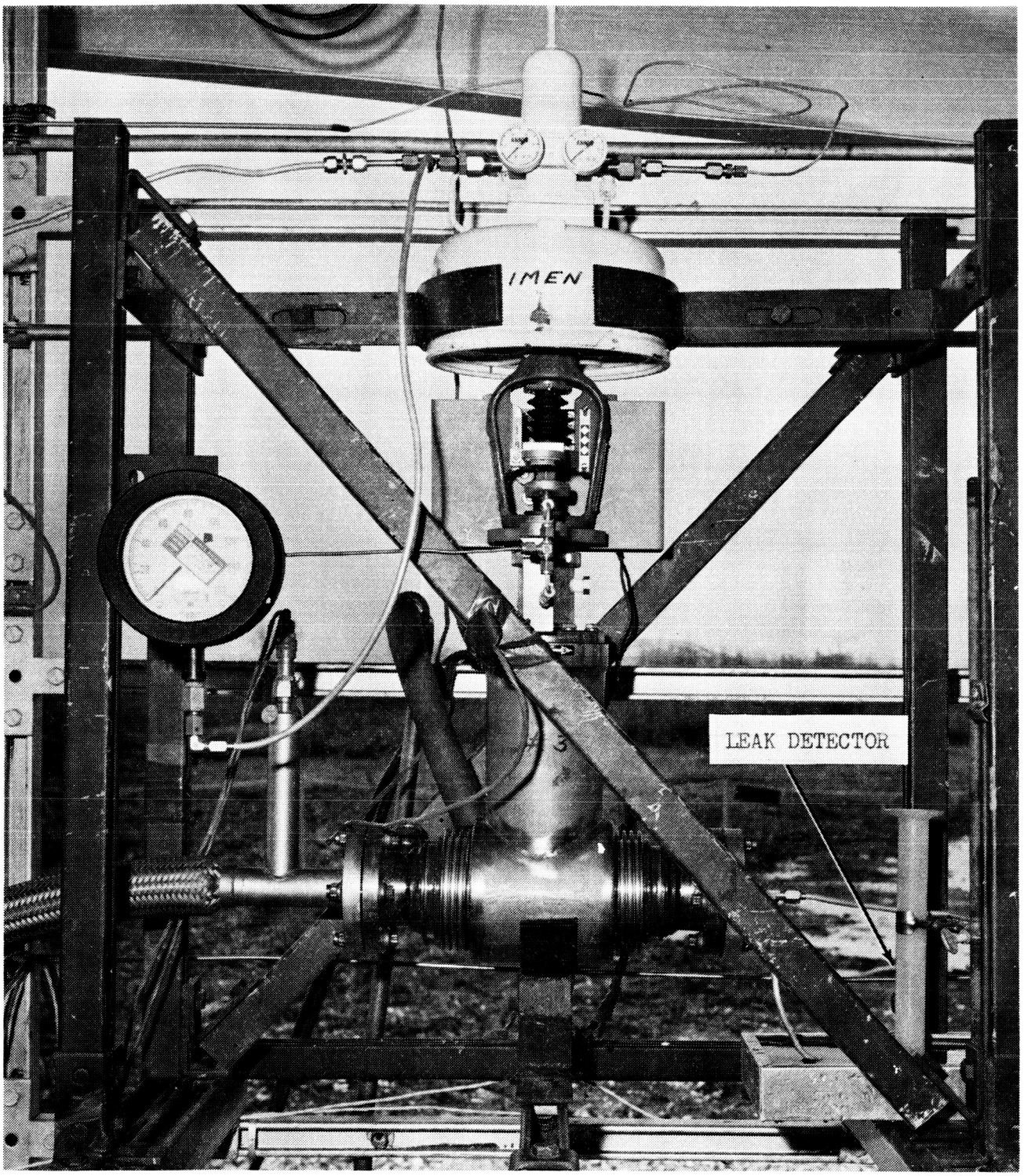


Figure 4-2. Functional Test Setup

SECTION V

TEMPERATURE SHOCK TEST

5.1 TEST REQUIREMENTS

5.1.1 PURGE

The purge described in paragraph 4.2.9, shall be conducted before and after the introduction of hydrogen into the system.

5.1.2 INTERNAL SEAT LEAKAGE

The procedures described in paragraph 4.1.1 shall be repeated except that the pressure shall be applied to the downstream side of the valve with 25-psig He at 125°F.

5.1.3 LOSS OF ACTUATOR PRESSURE

The procedures described in paragraph 4.1.2 shall be repeated except that no pressure shall be applied to the actuator supply or signal ports.

5.1.4 INTERNAL SEAT LEAKAGE

The specimen shall be stabilized at a temperature of 125°F. Using GH_2 at 25 and 100 psig and 125°F as the pressure medium for the specimen's valve body and GN_2 at 50 psig and 125°F as the pressure medium for the actuator. The downstream and upstream internal seat leakage tests, described in paragraph 4.2.6, shall be conducted.

5.1.5 LOSS OF ACTUATOR PRESSURE

The procedures described in paragraph 4.2.5 shall be repeated except that no pressure shall be applied to the actuator supply and actuator signal ports.

5.1.6 SHOCK

The specimen shall be cooled within 2 minutes by flowing GH_2 and then LH_2 through the specimen.

5.1.7 ACTUATOR SIGNAL PRESSURE

The procedures described in paragraph 4.2.7 shall be performed.

5.2 TEST PROCEDURE

5.2.1 Specimens 2 and 3 were installed as shown in figures 5-1 and 5-2 using the equipment listed in table 5-1. It was determined

that all connections were tight, gages were installed and operating properly, and all valves are closed.

5.2.2 The temperature of environmental chamber 50 was raised to 125°F and stabilized at that temperature.

5.2.3 DOWNSTREAM PRESSURIZATION

5.2.3.1 Regulator 8 was adjusted until a pressure of 50 psig was observed on gage 27.

5.2.3.2 The procedures described in paragraphs 4.2.2.3 through 4.2.2.5 and 4.2.3.1 through 4.2.3.4 were performed except LH_2 dewar container 42 was vented to 15 psig and repressurized with He to 25 psig.

5.2.3.3 Valves 13, 14, 15, 17, 39, 43, 44, 45, and 46, and back pressure regulator 38 were opened and the system was purged with GN_2.

5.2.3.4 Back pressure regulator 38 and valves 17, 15, 13, and 14 were closed in that order and 100-psig GN_2 was trapped in the system. The system was checked for leakage by monitoring transducers 30 and 31.

5.2.3.5 Valve 17 was opened momentarily and the pressure was bled to 15 psig. Valve 16 was opened and closed and hydrogen was introduced into the system. A leak check was performed.

5.2.3.6 Valve 17 was reopened momentarily and the pressure was bled to 20 psig.

5.2.3.7 Valve 45 was closed and valve 39 was moved to the vent position.

5.2.3.8 Valve 16 was opened momentarily and the specimen was pressurized with GH_2 at 25 psig. The temperature of the hydrogen was allowed to rise to 125°F.

5.2.3.9 Valve 17 was opened and leak detector 41 was connected as shown in figure 5-1B. Valve 17 was closed.

5.2.4 INTERNAL SEAT LEAKAGE TEST, SPECIMEN NUMBER 2

5.2.4.1 The specimen was checked for leakage by monitoring leak detector 41 for 5 minutes. The data were recorded.

5.2.5 LOSS OF ACTUATOR PRESSURE TEST, SPECIMEN NUMBER 2

5.2.5.1 Valve 44 was closed and valve 39 was moved to the vent position.

5.2.5.2 The specimen was checked for leakage by monitoring leak detector 41 for 5 minutes.

5.2.6 INTERNAL SEAT LEAKAGE TEST, SPECIMEN NUMBER 3

5.2.6.1 Valves 44 and 45 were opened, and specimen number 3 was closed. Valve 45 was closed after the specimen closed.

5.2.6.2 Regulator 8 was adjusted until a pressure of 50 psig was observed on gage 27.

5.2.6.3 Valve 39 and specimen number 2 were opened, valve 46 was closed, and valve 39 was moved to the vent position. Valve 45 was opened.

5.2.6.4 The specimen was checked for leakage by monitoring leak detector 41 for 5 minutes. The data were recorded.

5.2.7 LOSS OF ACTUATOR PRESSURE TEST, SPECIMEN NUMBER 3

5.2.7.1 Valve 43 was closed.

5.2.7.2 The specimen was checked for leakage by monitoring leak detector 41 for 5 minutes. The data were recorded.

5.2.8 SYSTEM PURGE

5.2.8.1 Leak detector 41 was removed and valves 43 and 46 were opened.

5.2.8.2 The purge procedure described in paragraph 4.2.8 was performed.

5.2.9 UPSTREAM PRESSURIZATION

5.2.9.1 The specimens were removed from the installation, turned 180 degrees, and reinstalled as shown in figure 5-1.

5.2.9.2 The downstream pressurization procedure, paragraph 5.2.3, was performed except LH_2 dewar container 42 was pressurized with He to 100 psig.

5.2.10 UPSTREAM LEAKAGE TESTS, SPECIMENS NUMBERS 2 AND 3

The tests described in paragraphs 5.2.3.9, 5.2.4, 5.2.5, 5.2.6, and 5.2.7 were performed on specimens 2 and 3 at 100 psig pressure.

5.2.11 TEMPERATURE SHOCK

5.2.11.1 Leak detector 41 was removed and valves 43 and 46 were opened.

5.2.11.2 Regulator 8 was adjusted until a pressure of 50 psig was observed on gage 27.

5.2.11.3 Valves 17, 39, and 16 were opened in that order and LH_2 flowed throught the specimens until thermometer 32 indicated a temperature of -423°F. Valves 17, and 46 were then closed, and valve 39 was moved to the vent position.

5.2.12 ACTUATOR SIGNAL PRESSURE TEST, SPECIMEN NUMBER 3

Regulator 8 was adjusted to 50 psig and the tests described in paragraphs 4.2.7 through 4.2.7.3 were performed on specimen 3.

5.2.13 ACTUATOR SIGNAL PRESSURE TESTS, SPECIMEN NUMBER 2

5.2.13.1 Regulator 8 was adjusted until 50 psig was observed on gage 27. Valve 46 was opened and specimen 2 was closed. Valve 46 was closed.

5.2.13.2 Valve 39 and specimen 3 were opened.

5.2.13.3 Valve 45 was closed, valve 39 was moved to the vent position, and valve 46 was opened.

5.2.13.4 The tests described in paragraphs 4.2.7.1 through 4.2.7.3 were performed on specimen 2.

5.2.14 PURGE

Valve 45 was opened and the purge procedure described in paragraph 4.2.8 was performed.

5.3 TEST RESULTS

Specimens number 2 and number 3 successfully completed the requirements of the temperature shock test except the minimum signal pressure requirements for specimen number 3 was out of tolerance. An extra test was performed on specimen number 3 to determine the minimum actuator pressure. Minimum actuator pressure was determined to be 25 psig.

5.4 TEST DATA

The data recorded during the temperature shock test are presented in tables 5-2 and 5-3.

Table 5-1. Temperature Shock Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Specimen	Annin Company	1760	NA	
2	Pressure Source		NA	NA	3000 psig GN_2
3	Hand Valve	Hoke	PY273	NA	
4	Pressure Gage	Union Carbine	29172-1	NA	0-to 100-psig
5	Pressure Gage	Union Carbine	29172-1	NA	0-to 100-psig
6	Pressure Gage	Union Carbine	29177-1	NA	0-to 100-psig
7	Pressure Regulator	Victor	SR431	859279	0-to 50-psig
8	Pressure Regulator	Victor	SR431	859273	0-to 150-psig
9	Pressure Regulator	Victor	SR431	859203	0-to 150-psig
10	Pressure Gage	Victor	22660-1	NA	0-to 1000-psig
11	Pressure Gage	Union Carbine	29172-1	NA	0-to 100-psig
12	Pressure Gage	Victor	22660-1	NA	0-to 4000-psig
13	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
14	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
15	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
16	Pneumatic Valve	Hoke	OR294AJ	NA	Hand Valve
17	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
18	Hand Valve	Control Conponents	30455	NA	¼-inch
19	Hand Valve	Powell	NA	8157	
20	Pressure Gage	US Gauge Company	10895	NA	0-to 300-psig ± 0.5 % FS
21	Pressure Gage	Super Gauge	-B-	106-1121 B	0-to 160-psig ± 0.5 % FS Cal date 10/7/66

Table 5-1. Temperature Shock Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
22	Pressure Gage	Victor	30-205-203	NA	0-to 1000-psig Ref
23	Pressure Regulator	Victor	701N	869954	0-to 250-psig Ref
24	Hand Valve	Airco	NA	NA	
25	Pressure Source	Airco	NA	NA	1800-psig He
26	Pressure Gage	Duragauge	-B-	95-1560-B	0-to 30-psig ± 0.5 % FS Cal date 10-7-66
27	Pressure Gage	Heise	-B-	951398-B	0-to 160-psig ± 0.1 % FS Cal date 10-7-66
28	Pressure Gage	Supergage	-B-	1061119-B	0-to 160-psig ± 0.5 % FS Cal date 10-7-66
29	Pressure Gage	Heise	-B-	95-1376-B	0-to 60-psig ± 0.1 % FS Cal date 10-7-66
30	Pressure Transducer	CEC	NA	018169	0-to 60-psig 0.5% FS Cal date 10-7-66
31	Pressure Transducer	CEC	NA	018170	0-to 100-psig 0.5% FS Cal date 10-7-66
32	Resistance Thermometer	Rosemount	150MA32	6454	-415 to -430°F ±0.5°F
33	Thermocouple	Copper Constantan	NA	NA	cu, con ±2°F
34	Vacuum Thermocouple	NRC Equipment Corp.	Type 0521	NA	±10% accuracy Cal date 9-15-66
35	Vacuum Valve	Cryolab	SVI 84-5W2	NA	½-inch
36	Vacuum Pump	Welch	010587	9863-97	
37	Check Valve	Lukenheiman	2144	NA	2-inch, ventical
38	Back Pressure	Fisher	NA	4140132	1-inch
39	Hand Valve	Republic Mfg.	NA	424	¼-inch
40	Recording Oscillograph	CEC	NA	012592	Cal date 6-27-67

Table 5-1. Temperature Shock Test Equipment List

(Sheet 3 of 3)

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
41	Leak Detector	CCSD	NA	NA	
42	175 Liter Dewar	Cryenco	195-L	1158-19	LH_2
43	Hand Valve	Robbins	55KG250	NA	6000-psi
44	Hand Valve	Robbins	55KG250	NA	6000-psi
45	Hand Valve	Robbins	55KG250	NA	6000-psi
46	Hand Valve	Robbins	55KG250	NA	6000-psi
47	Solenoid Valve	Marotta	MU74	NA	3000-psig
48	Timer	Wilson	Mod #1	NA	Repeat cycle timer
49	Venting Regulater	Tescom	26-1610 42-031	2505	0 to 100-psig
50	Environmental Chamber	CCSD	NA	NA	

Table 5-2. Temperature Shock Data

TEST DATA SHEET — Specimen No. 2

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Internal Seat Leakage	GH_2	110	110	15	100	0	50	2.9	0	0		Ok	0 1/4 1/2 3/4 Full	4795 62			
	Loss of psi	GH_2	110	110	15	100	0	0	0	0	0							
	Flow of LH_2	LH_2	-412	100	10	100	100	50	2.9	-	-	OK	OK	0 1/4 1/2 3/4 Full	4795 62	2.9 5.8 8.6 10.4 15.0	5.6	6.1
DOWNSTREAM	Internal Seat Leakage	GH_2	98	105	10	0	25	50	2.9	0	0		OK					
	Loss of psi	GH_2	98	105	10	0	25	0	0	0	0		OK					
					NOT REQUIRED													

Table 5-3. Temperature Shock Data

TEST DATA SHEET — Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Seat Leakage	GH_2	110	110	15	100	0	50	2.7	.2	0		OK	0 1/4 1/2 3/4 Full				
UPSTREAM	Loss of psi	GH_2	112	110	15	100	0	0	0	2.0	0		OK					
UPSTREAM	Flow of LH_2	LH_2	-418	105	15	100	100	50	2.7					0 1/4 1/2 3/4 Full	4815 214	2.7 5.8 8.5 10.5 15.0	4.4	5.6
DOWNSTREAM	Internal Seat Leakage	GH_2	110	110	15	0	25	50	2.7	0	0		OK					
DOWNSTREAM	Loss of psi	LH_2	110	110	15	0	25	0	0	0	0		OK					
DOWNSTREAM	*Flow of LH_2	LH_2	-405	105	15	100	0	25	2.7	NA	NA	OK	OK	0 1/4 1/2 3/4 Full	4815 214	2.7 5.9 9.2 12.3 Failed	21.3	5.4

*Extra test to determine effects @ 25 psig actuate pressure.

Note: All lines $\frac{1}{4}$ inch unless otherwise indicated.
Refer to table 5-1 for item identification.

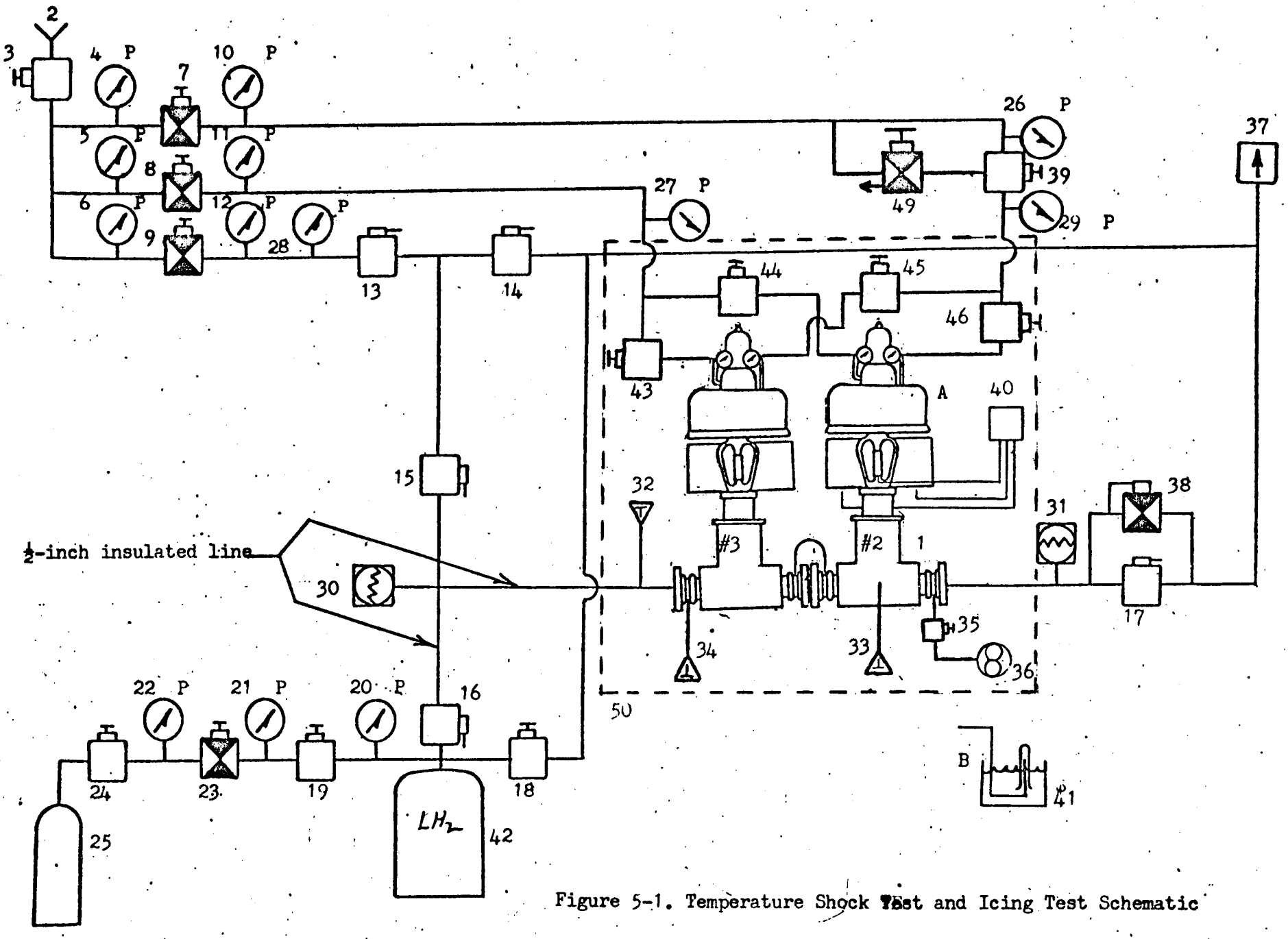


Figure 5-1. Temperature Shock Test and Icing Test Schematic

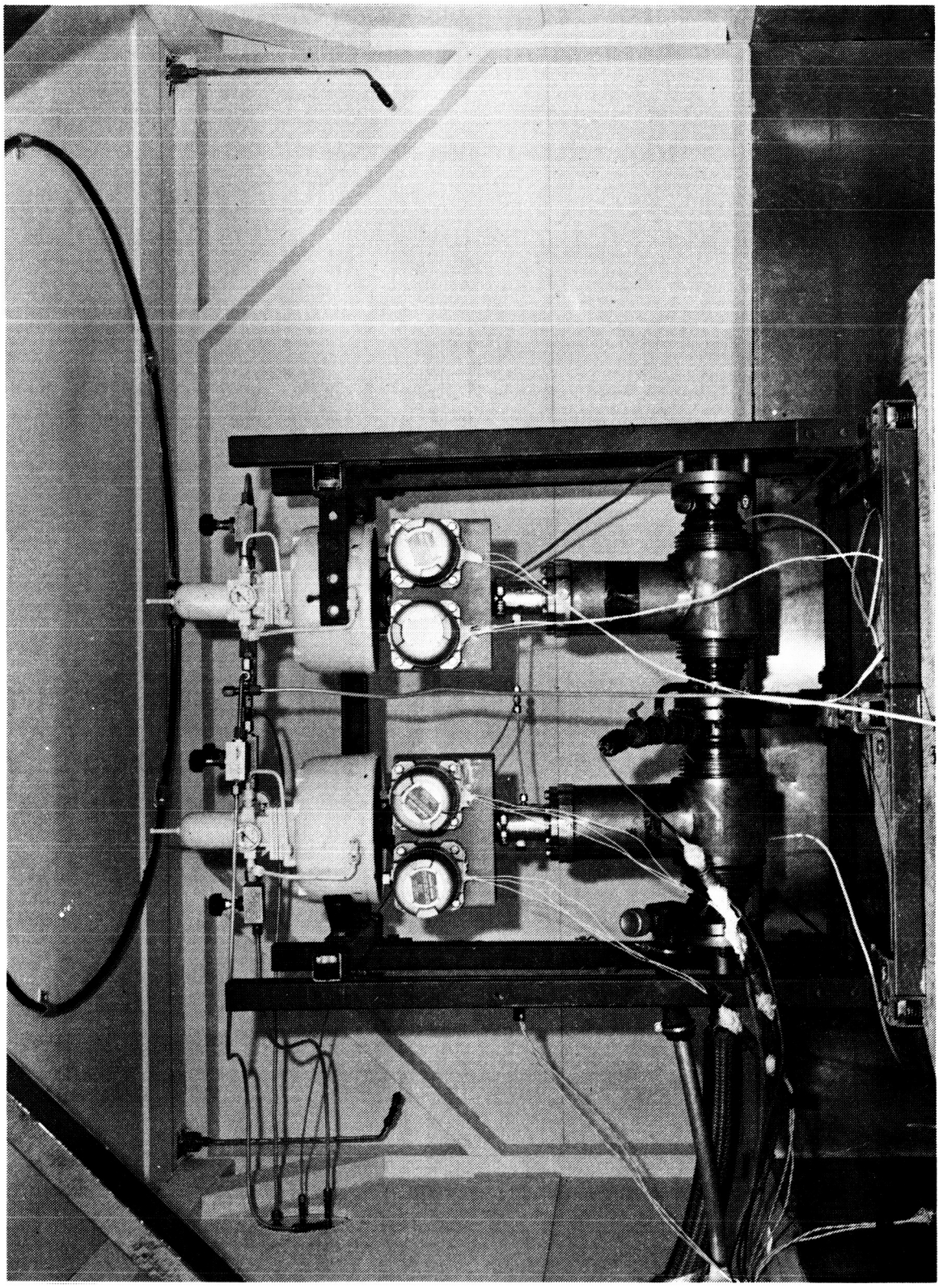


Figure 5-2. Temperature Shock Test Setup

SECTION VI

INSULATION RESISTANCE TEST

6.1 TEST REQUIREMENTS

6.1.1 SWITCHES

The insulation resistance shall be 20 megohms at 500 vdc applied for a minimum time of 60 seconds between all nonconnected terminals and between all terminals and the case.

6.1.2 BOURNS INDICATOR

The insulation resistance shall be 20 megohms at 500 vdc applied for a minimum time of 60 seconds between all nonconnected terminals and the case.

6.2 TEST PROCEDURE

6.2.1 SWITCHES

Using a megohmeter, the electrical resistance between all nonconnected terminals and between all terminals and the case of the actuator position switches was checked. Five hundred (500) vdc was applied for 60 seconds and the resistance in megohms was recorded.

6.2.2 BOURNS INDICATOR

The length of the Bourns indicator output leads was measured in feet and recorded. The electrical resistance between all nonconnected terminals and between all terminals and the case was checked with a megohmeter. Five hundred (500) vdc was applied for 60 seconds and the electrical resistance in megohms was recorded.

6.3 TEST RESULTS

6.3.1 The three specimen's successfully completed the requirements of the insulation resistance test.

6.4 TEST DATA

6.4.1 The data recorded during the insuation resistance test are shown in tables 6-2, 6-3 and 6-4.

Table 6-1. Insulation Resistance Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Megohmeter	General Radio Company	1862-C	018415	Cal date 5-20-66 ±5% accuracy

Table 6-2. Insulation Resistance Test Data

INSULATION RESISTANCE DATA SHEET

Specimen No. 1

TESTS	INSULATION RESISTANCE OF SWITCHES (Megohms)		REFERENCE TP-RE-FO-1045-2R
TERMINALS	OPEN SWITCH	CLOSED SWITCH	ALLOWABLE LIMITS. PAR 6.2.2
OPEN to CASE	300	300	500 vdc applied for 60 seconds. Minimum resistance allowed - 20 Megohms
CLOSED to CASE	300	300	
COMMON to CASE	300	300	
OPEN to CLOSED	300	300	
CLOSED to COMMON	-0-	300	
OPEN to COMMON	300	-0-	

BOURNS INDICATOR TERMINALS	INSULATION (Megohms)	BOURNS TERMINALS	RESISTANCE (Ohms)	ALLOWABLE LIMITS. PAR 6.2.2
A to CASE	100	A - B	4966	500 vdc applied for 60 seconds. Minimum resistance allowed - 20 Megohms
B to CASE	100	A - D	4961	
D to CASE	100	B- D	7	

Table 6-3. Insulation Resistance Test Data

INSULATION RESISTANCE DATA SHEET

Specimen No. 2

TESTS	INSULATION RESISTANCE OF SWITCHES (Megohms)		REFERENCE TP-RE-FO-1045-2R
TERMINALS	OPEN SWITCH	CLOSED SWITCH	ALLOWABLE LIMITS. PAR 6.2.2
OPEN to CASE	600	550	500 vdc applied for 60 seconds. Minimum resistance allowed - 20 Megohms
CLOSED to CASE	600	550	
COMMON to CASE	600	550	
OPEN to CLOSED	600	550	
CLOSED to COMMON	-0-	550	
OPEN to COMMON	600	0	

BOURNS INDICATOR TERMINALS	INSULATION (Megohms)	BOURNS TERMINALS	RESISTANCE (Ohms)	ALLOWABLE LIMITS. PAR 6.2.2
A to CASE	100	A - B	4960	500 vdc applied for 60 seconds. Minimum resistance allowed - 20 Megohms
B to CASE	100	A - D	4511	
D to CASE	100	B- D	437.2	

Table 6-4. Insulation Resistance Test Data

INSULATION RESISTANCE DATA SHEET			Specimen No. 3
TESTS	INSULATION RESISTANCE OF SWITCHES (Megohms)		REFERENCE TP-RE-FO-1045-2R
TERMINALS	OPEN SWITCH	CLOSED SWITCH	ALLOWABLE LIMITS. PAR 6.2.2
OPEN to CASE	300	350	500 vdc applied for 60 seconds. Minimum resistance allowed - 20 Megohms
CLOSED to CASE	300	350	
COMMON to CASE	300	350	
OPEN to CLOSED	300	350	
CLOSED to COMMON	0	350	
OPEN to COMMON	300	0	

BOURNS INDICATOR TERMINALS	INSULATION (Megohms)	BOURNS TERMINALS	RESISTANCE (Ohms)	ALLOWABLE LIMITS. PAR 6.2.2
A to CASE	100	A - B	4905	500 vdc applied for 60 seconds. Minimum resistance allowed - 20 Megohms
B to CASE	100	A - D	4887	
D to CASE	100	B- D	1.1	

SECTION VII

ICING TEST

7.1 TEST REQUIREMENTS

7.1.1 An icing test shall be performed to determine the ability of the specimen to perform under iced conditions.

7.1.2 The icing test shall be performed in accordance with section 14 of KSC-STD-164(D).

7.1.3 The temperature in the test chamber shall be regulated and maintained at 5°F.

7.1.4 Spray nozzles shall emit water in droplets of 1.5 milimeters minimum diameter.

7.1.5 Water, precooled to 40°F, shall flow through each spray nozzle at a rate of approximately 2 gallons per minute.

7.1.6 The spray nozzles shall be located at a minimum distance of 2 feet from the specimen.

7.1.7 Functional tests shall be performed during and after the icing test.

7.2 TEST PROCEDURE

7.2.1 Specimens 2 and 3 were installed as shown in figure 5-1A and placed in environmental chamber (50).

7.2.2 The temperature in environmental chamber (50) was stabilized of +5°F.

7.2.3 Water of 40°F was injected into the chamber. The injection of the water was continued until a minimum of ½-inch of ice had formed on the specimens. (Figure 7-1).

7.2.4 DOWNSTREAM PRESSU RIZATION

7.2.4.1 The procedures described in paragraph 4.2.2.3 through 4.2.2.5 and 4.2.3.1 through 4.2.3.4 were performed.

7.2.4.2 The procedures described in paragraphs 5.2.3.3 through 5.2.3.5 were performed.

7.2.4.3 Valves 16 and 17 were opened and hydrogen flowed through the system. When thermometer 32 indicated a temperature of -423°F, valve 45 was closed and valve 39 was moved to the vent position.

7.2.5 DOWNSTREAM LEAKAGE TESTS

7.2.5.1 Leak detector 41 was installed as shown in figure 5-1B and valve 17 was closed.

7.2.5.2 The tests described in paragraphs 5.2.4, 5.2.5, 5.2.6, and 5.2.7 were performed.

7.2.6 PURGE

The purge procedure described in paragraph 5.2.8 was performed.

7.2.7 UPSTREAM PRESSURIZATION

7.2.7.1 The specimens were removed from the installation, turned 180 degrees, and reinstalled as shown in figure 5-1B.

7.2.7.2 The procedures described in paragraphs 4.2.3.1 through 4.2.3.4 were performed.

7.2.7.3 The procedures described in paragraphs 5.2.3.3 and 5.2.3.4 were performed.

7.2.8 UPSTREAM LEAKAGE TESTS

7.2.8.1 Leak detector 41 was installed as shown in figure 5-1B and valve 17 was closed.

7.2.8.2 The tests described in paragraphs 5.2.4, 5.2.5, 5.2.6, and 5.2.7 were performed on specimens 2 and 3 at 100 psig pressure.

7.2.9 ACTUATOR SIGNAL PRESSURE

7.2.9.1 Leak detector 41 was removed and valve 43 was opened.

7.2.9.2 Regulator 8 was adjusted until a pressure of 50 psig was observed on gage 27.

7.2.9.3 The procedures described in paragraphs 4.2.7.1 through 4.2.7.3 were conducted on specimens number 3.

7.2.9.4 Valve 46 was opened and after specimen number 2 closed valve 46 was closed.

7.2.9.4 Valve 39 was opened and opening pressure was supplied to specimen number 3. After specimen number 3 opened, valve 45 was closed, and valve 39 was returned to the vent position. Valve 46 was opened.

7.2.9.5 The procedures described in paragraphs 4.2.7.1 through 4.2.7.3 were conducted on specimen number 2. Valve 45 was opened at completion of the test.

7.2.10 PURGE

The purge described in paragraph 4.2.8 was performed.

7.2.10.1 The environmental chamber was returned to ambient conditions.

7.2.11 Within 1 hour after the icing test had been completed a functional test was performed as described in paragraphs 7.2.4.1 through 7.2.9.

7.3 TEST RESULTS

7.3.1 SPECIMEN NUMBER 2

7.3.1.1 During the icing functional test the specimen began leaking at the packing flange gland. The gland was tightened and the leak was curtailed. The specimen successfully completed the post-icing functional test.

7.3.2 SPECIMEN NUMBER 3

The specimen successfully completed the icing and post-icing functional test except the minimum signal pressure and actuator pressure were out of tolerance.

7.4 TEST DATA

The data recorded during the icing and post-icing functional tests are presented in tables 7-1, 7-2, 7-3 and 7-4.

Table 7-1. Icing Test Data

TEST DATA SHEET — Specimen No. 2

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Internal Seat	GH_2	-418	10	12	100	0	50	2.9	5.2	0	OK	OK	0	4790		4.1	3.9
														1/4		5.8		
														1/2		8.9		
														3/4		12.1		
														Full	60	15.0		
	Loss of psi	GH_2	-418	10	12	100	0	0	2.9	6.3	0		OK					
		NOT REQUIRED												0				
														1/4				
														1/2				
														3/4				
														Full				
DOWNSTREAM	Internal Seat	GH_2	-4.8	10	12	0	25	50	2.9	0	⚠*							
	Loss of psi	GH_2	-418	10	12	0	25	0	0	0	⚠*							
	Internal Seat	GH_2	-418	10	12	0	25	0	0	0	⚠*							

⚠* Excessive seat leakage about valve stem 6SE 067

Table 7-2. Post-Icing Functional Test Data

TEST DATA SHEET — Specimen No. 2

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Internal Seat	GH_2	-418	60	25	100	0	20	2.9	2.5	0			0	4479	2.9		
														1/4		6.5		
														1/2		9.6	13.0	6.0
														3/4		12.9		
														Full	1.2	15.0		
	Loss of psi	GH_2	-418	60	25	100	0	0	0	2.0	0							
	Internal Seat	GH_2	-418	60	25	100	0	50	2.9	2.0	0			0	4479	2.9		
														1/4		5.9		
														1/2		9.4	4.5	4.0
														3/4		12.5		
														Full	1.2	15.0		
DOWNSTREAM	Internal Seat	GH_2	-418	60	25	0	25	50	2.9	2.9								
	Loss of psi	GH_2	-418	60	25	0	25	0	0	0	0							
		NOT REQUIRED																

Table 7-3. Icing Test Data

TEST DATA SHEET — Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act.	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat Leakage	LH_2	-420	10	12	100	0	50	* 2.6	0	0	OK	OK	0	4822	2.7	4.5	6.3
														1/4		5.8		
														1/2		8.8		
														3/4		12.0		
														Full	214	15.0		
	Loss of psi	LH_2	-420	10	12	100	0	0		0	0		OK					
														0				
														1/4				
		NOT REQUIRED												1/2				
														3/4				
														Full				
DOWN STREAM	Internal Seat Leakage	LH_2	-420	10	12	0	25	50	2.6				OK					
	Loss of psi	LH_2	-420	10	12	0	25	0	0	0	0		OK					
		NOT REQUIRED																

* Note change of signal pressure

Table 7-4. Post-Icing Test Functional Data

TEST DATA SHEET — Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat Leakage	GH_2	-417	60	25	100	0	25	2.6	2.0	0	OK	OK	0	4825	2.6	15.0	5.8
														1/4		6.0		
														1/2		9.1		
														3/4		12.2		
														Full	213	15.0		
	Loss of psi	GH_2	-417	60	25	100	0	0	0	7.3	0		OK					
	Internal Seat Leakage	GH_2	-417	60	25	100	0	50	2.6	4.7				0	4825	2.6	4.4	6.0
														1/4		5.8		
														1/2		8.8		
														3/4		12.0		
														Full	213	15		
DOWN STREAM	Internal Seat Leakage	LH_2	-412	62	25	0	25	50	2.6	2.5			OK					
	Loss of psi	LH_2	-412	62	25	0	25	0	0	2.7			OK					
		NOT REQUIRED																

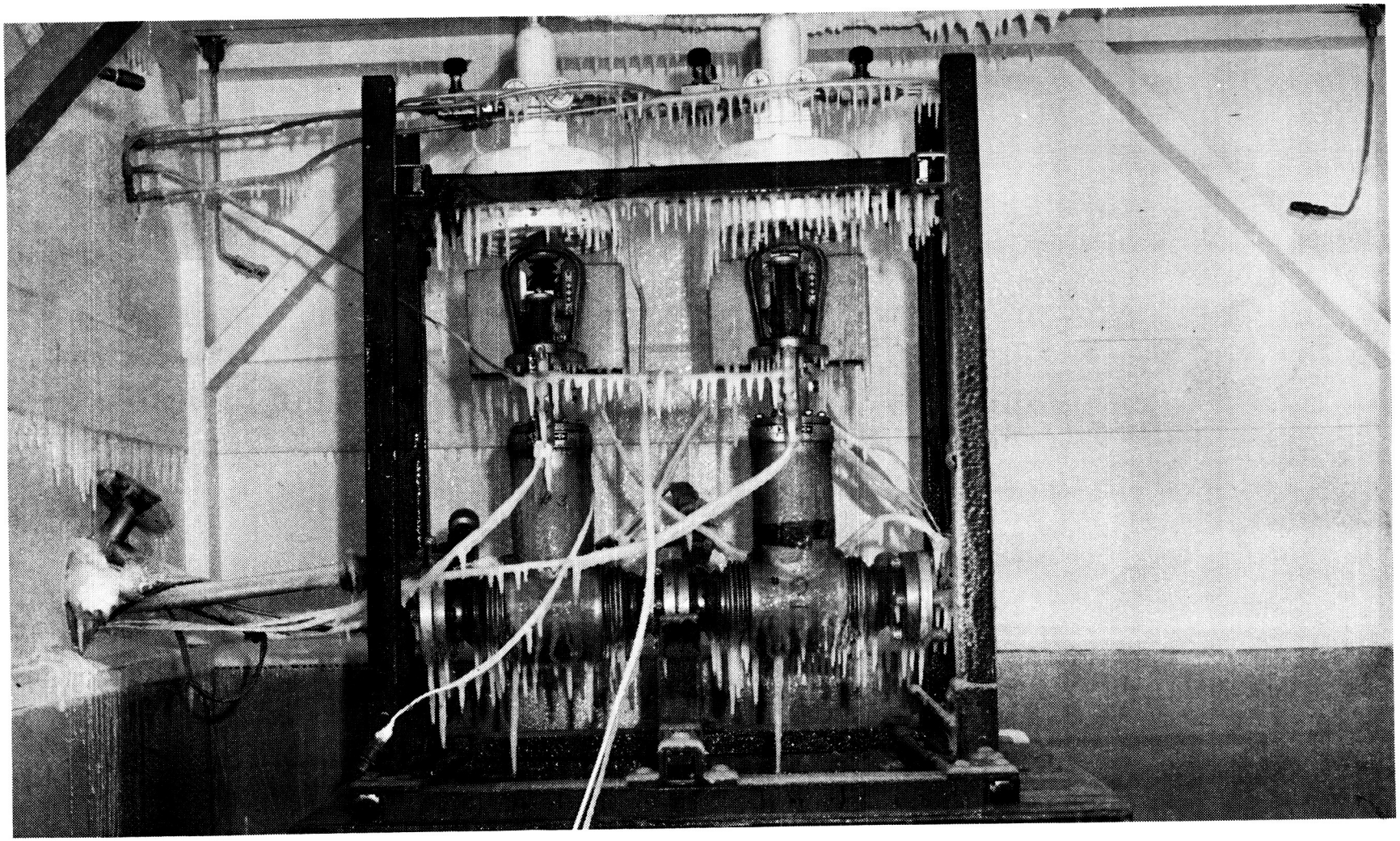


Figure 7-1. Icing Test Setup

SECTION VIII

CYCLE TEST

8.1 TEST REQUIREMENTS

8.1.1 The specimen shall be subjected to a total of 3000 cycles using LH_2 at 100 psig as the test medium for the valve and GN_2 at 50 psig as the test medium for the actuator supply.

8.1.3 A cycle shall consist of opening and then closing the valve.

8.1.3 The actuator position switches shall be loaded to 10 amperes resistive load and 28 vdc during the cycle test.

8.1.4 A functional test shall be conducted after 100, 500, 1000, and 3000 cycles.

8.2 TEST PROCEDURE

8.2.1.1 The specimen was installed as shown in figure 8-1A using the equipment listed in table 8-1. It was determined that all connections were tight, all gages were installed and operating properly, and that all valves were closed.

8.2.1.2 A functional test was performed on specimen 1 because 72 hours had elapsed since the specimen had been previously tested. Specimens 2 and 3 did not require any pre-test functional testing.

8.2.2 The actuator position switches were loaded to 10 amperes resistive load.

8.2.3 CYCLING

8.2.3.1 The procedures described in paragraphs 4.2.2.2 through 4.2.2.5 were performed except regulator 8 was adjusted for a pressure of 50 psig.

8.2.3.2 The procedures described in paragraphs 4.2.3.1 through 4.2.3.6 were performed.

8.2.3.3 Valve 16 was opened. Solenoid valve 47 was actuated, deactuated and actuated by timer 48. These actions allowed the specimen to close, open, and close. This activity constituted 1 cycle.

8.2.3.4 Three thousand cycles were performed.

8.2.4 FUNCTIONAL TEST

A functional test as described in paragraphs 4.2.4 through 4.2.10 was performed after 100, 500, 1000, and 3000 cycles.

8.2.6 PURGE

A purge ws described in paragraph 4.2.8 was performed after the functional test at 3000 cycles.

8.3 TEST RESULTS

8.3.1 **SPECIMEN 1**

The specimen failed the precycle functional test. The valve cracked at a signal pressure of 2.4 psig and a 50 psig actuator pressure. The specimen was disassembled and the springbutton adjusting assembly of the domotor was found to have rotated. This rotation changed the signal pressure. The failure is shown in figures 8-3 and 8-4. The two adjustment screws provided on the button will not lock on the retainer seal tube. This failure allows rotation of the button and changes the signal pressure, cracking pressure, and reseat pressure. Although the lock screws were torqued until the screw slots failed, the button was still able to be rotated with the consequent changes of adjustments.

8.3.1.1 The two adjustment screws from specimen 2 were used to replace the screws from specimen 1. These screws seemed to function properly and retain the button in one position. The specimen was reassembled and readjusted according to CCSD-FO instructions dated 12-12-66.

8.3.1.2 The signal pressure adjustment mechanism of the specimen cannot be relied upon to maintain an exact adjustment as required by John F. Kennedy Space Center. The exact cause could not be determined due to the limited scope of the test procedure but test results indicate the following problem areas:

a) Insufficient mechanical locking of the springbuttons.

b) The valve adjustment mechanism cannot furnish adequate control of the domotor mechanism.

8.3.1.3 The specimen failed the leakage requirements after 1500 cycles. Testing revealed that the internal valve seats began failing after 1000 cycles. This was caused by deterioration of the valve seat material.

8.3.2 **SPECIMEN 2**

8.3.2.1 The specimen was tested within the specified signal pressure range of 2.9 to 15 psig.

8.3.2.2 The specimen failed the leakage requirements after 1000 cycles. The valve was disassembled and inspected. The valve plug (SS) was worn, the seal-seat (Kel-F) was worn, the seal-creavey (Teflon) was compressed and the pressure ring (SS) was loose. This is shown in figures 8-5 and 8-6.

8.3.3 **SPECIMEN 3**

8.3.3.1 The specimen was tested within a signal pressure range of 2.4 to 15 psig.

8.3.3.2 The specimen failed the leakage requirements upon completion of the 3000 cycles. It is believed that the failure may have begun after 1500 cycles.

8.3.3.3 Upon completion of the cycle test the specimen was adjusted as per CCSD-FO instructions dated 12-2-66 and 12-5-66. An additional functional test was conducted on 1-11-67. The signal pressure adjustments were found to have changed. The specimens cracking pressure was 2.8 psig, but was originally adjusted for 3.0 psig. This change occurred during layup or aging and was not due to any functional operations.

8.3.3.4 The specimen was readjusted and the internal leakage failed to meet the test requirements. Readjustment of the specimen did not overcome the previous leakage failures.

8.4 CONCLUSION

The signal pressure adjustment of the domotor will not maintain the specimen within the minimum 2.9 psig signal pressure requirements.

8.4.1 The valve plug and seat seal will not withstand more than 1000 cycles and still remain within the specified internal leakage requirements.

Table 8-1. Cycle Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
1	Test Specimen	Annin Company	1760	NA	
2	Pressure Source		NA	NA	3000-psig GN_2
3	Hand Valve	Hoke	PY273	NA	¼-inch
4	Pressure Gage	Union Carbide	29172-1	NA	0-to 100-psig
5	Pressure Gage	Union Carbide	29172-1	NA	0-to 100-psig
6	Pressure Gage	Union Carbide	29177-1	NA	0-to 400-psig
7	Pressure Regulator	Victor	SR431	859279	0-to 50-psig
8	Pressure Regulator	Victor	SR431	859273	0-to 150-psig
9	Pressure Regulator	Victor	SR431	859203	0-to 150-psig
10	Pressure Gage	Victor	22660-1	NA	0-to 1000-psig
11	Pressure Gage	Union Carbide	29177-1	NA	0-to 400-psig
12	Pressure Gage	Victor	22660-1	NA	0-to 4000-psig
13	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
14	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
15	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
16	Pneumatic Valve	Hoke	DR294AJ	NA	¼-inch
17	Pneumatic Valve	Hoke	30201-1	NA	¼-inch
18	Hand Valve	Control Components	30455	NA	¼-inch
19	Hand Valve	Powell	NA	8157	
20	Pressure Gage	US Gauge CD	10895	NA	0-to 30-Vac 0-to 300-psig
21	Pressure Gage	Supergauge	-B-	106-1121-B	0-to 160-psig ±0.5% FS Cal date 10-1-66
22	Pressure Gage	Victor	30-205-203	NA	0-to 4000-psig
23	Pressure Regulator	Victor	701N	869954	0-to 250-psig
24	Hand Valve	Airco	NA	NA	
25	Pressure Source	Airco Helium Bottle	NA	NA	1800-psig He
26	Pressure Gage	Duragauge	-B-	95-1560-B	0-to 30-psig ±0.5% FS Cal date 10-7-66
27	Pressure Gage	Heise	-B-	951398-B	0-to 160-psig ±0.5% FS Cal date 10-7-66
28	Pressure Gage	Supergauge	-B-	106-1119-B	0-to 160-psig ± 0.5 % FS Cal date 10-7-66

Table 8-1. Cycle Test Equipment List

Item No.	Item	Manufacturer	Model/ Part No.	Serial No.	Remarks
29	Pressure Gage	Heise	-B-	95-1376-B	0-to 60-psig ± 0.1 % FS Cal date 10-7-66
30	Pressure Transducer	CEC	NA	018169	0-to 100-psig ±0.5% FS Cal date 10-7-66
31	Pressure Transducer	CEC	NA	018170	0-to 100-psig ±0.5% FS Cal date 10-7-66
32	Resistance Thermometer	Rosemount	150MA32	6454	-415 to -430 °F ±0.5°F
33	Thermocouple	Copper Constantan	NA	NA	cu, con ±2°F
34	Vacuum Thermocouple	NRC Equipment Corp.	Type 0521	NA	Cal date 9-15-66
35	Vacuum Valve	Cryolab	SVI 84-5W2	NA	½-inch
36	Vacuum Pump	Welch	010587	9863-97	
37	Check Valve	Lukenheiman	2144	NA	2-inch, ventical
38	Back Pressure Regulator	Fisher	NA	4140132	1-inch
39	Hand Valve	Republic Mfg.	NA	424	¼-inch
40	Recording Oscillograph	CEC	NA	012592	Cal date 6-27-67
41	Leak Detector	CCSD	NA	NA	
42	175 Liter Dewar	Cryenco	195-L	1158-19	LH_2
43	Hand Valve	Robbins	55KG250	NA	6000-psi
44	Hand Valve	Robbins	55KG250	NA	6000-psi
45	Hand Valve	Robbins	55KG250	NA	6000-psi
46	Hand Valve	Robbins	55KG250	NA	6000-psi
47	Solenoid Valve	Marotta	MR74	NA	3000-psig
48	Timer	Wilson	Mod #1	NA	Repeat cycle timer
49	Venting Kegulater	Tescom	26-1610 42-031	2505	0-to 100-psig
50	Environmental Chamber	CCSD	NA	NA	
51	DC Power Supply	Lambda	LA-100-03-BM3	010265	28-VDC Cal date 10-16-66
52	Load Resistor	Sun-Elec. Company		08-113 010851	10 Amperes Cal date 8-4-66
53	Ammeter	Sun-Elec. Company	NA	NA	Cal date 8-4-66

Table 8-2. Pre-Cycle Functional Test Data

TEST DATA SHEET

Specimen No. 1

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat	GH_2	-418	46.4	2	100	0	20	2.9	*2				0 1/4 1/2 3/4 Full			*1	
	Loss of psi	GH_2	-418	46.4	2	100	0	0	0	0	0		OK					
	Internal Seat	GH_2	-418	46.4	2	100	0	50	2.3 2.4	0 *3	0	OK	OK	0 1/4 1/2 3/4 Full		2.3 5.0 8.3 11.4 14.7	4.0	3.0
DOWN STREAM	Internal Seat	GH_2	-418	46.4	2	0	25	50	2.3 2.4	0 *3	0							
	Loss of psi	GH_2	-418	46.	2	0	25	0	0	0	0							
	Internal Seat	GH_2	-418	46	2	0	25		2.7 2.8	0 *4	0							

Remarks *1 Valve leaks vigorously until signal press reduced to 2.5 psig; there is no leakage at this pressure (GSE064)

*2 Valve opens only 1/8 full travel at 20 psig actuator pressure. It opens fully at 27 psig actuator pressure

*3 Valve cracks at 2.4 signal pressure.

*4 Valve cracks @ 2.8 psig.

Table 8-3. Post-100 Cycle Functional Test Data

TEST DATA SHEET — Specimen No. 1

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act.	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat	GH_2	-418	+50.5	1	100	0	20	2.9	0	0		OK	0				
								25	2.9	0	0			1/4				
								20	3.1	Valve cracks				1/2				
														3/4				
														Full				
	Loss of psi	GH_2	-418	50.5	1	100	0	0	0	0	0							
	Internal Seat	GH_2	418	50.5	1	100	0	50	2.6	0	0			0		2.7		
														1/4		5.5		
								50	2.7*	Excessive				1/2		8.5	4.0	4.5
														3/4		11.7		
														Full		14.9		
DOWN STREAM	Internal Seat	GH_2	-418	+50.5	1	0	25	50	2.7	0	0							
									2.8	Valve Cracks								
	Loss of psi	GH_2	-418	50.5	1	0	25	0	0	0	0							
	Internal Seat	GH_2	-418	50.5	1	0	25	20	3.0	0	0							

* Cracking pressure changed to 2.7 psig

Table 8-4. Post-500 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 1

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Internal Seat	GH_2	-418	62	12.0	100	0	20	2.8	12cc/min		*1		0 1/4 1/2 3/4 Full			*2	
	Loss of psi	GH_2	-418	62	12.0	100	0	0	0	14								
	Internal Seat	GH_2	-418	62	12.0	100 100	0 0	50 50	2.8 2.9	14 Valve cracks				0 1/4 1/2 3/4 Full		2.8 5.8 9.1 12.0 15.2	4.0	4.0
DOWNSTREAM	Internal Seat	GH_2	-418	62	12.0			50	2.8	4.0								
	Loss of psi	GH_2	-418	62	12.0	0	25	0	0	6.0	0							
	Internal Seat	GH_2	-418	62	12.0	0	25	0	2.8	5.5	0							

*1 Valve cracks at 2.95 signal pressure and reseats at 2.90

*2 20 psig will not open valve - 27 psig will

Table 8-5. Post-1000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 1

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat	GH_2	-418	58	10.0	100	0	20	2.8	11.0				0 1/4 1/2 3/4 Full				
	Loss of psi	GH_2	-418	58	10.0	100	0	0	0	9.5								
	Internal Seat	GH_2	-418	58	10.0	100	0	50	2.8	16.0 Δ				0 1/4 1/2 3/4 Full		2.8 * 5.8 9.0 12.1 15.0	4.2	4.0
DOWN STREAM	Internal Seat	GH_2	-418	58	10.0		25	20	2.8	9.0	cc/min							
	Loss of psi	GH_2	-418	58	10.0		25	0	0	8.5								
	Internal Seat	GH_2	-418	58	10.0		25	50	2.8	10.5								

* Cracking pressure at 3.0 signal pressure

Δ = indicates failure

Table 8-6 Post-1500 Cycles Leak Test Data

TEST DATA SHEET

Specimen No. 1

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM														0 1/4 1/2 3/4 Full				
	Internal Seat	GH_2	-418	47	12	100	0	50	2.8	35 Δ	0		OK	0 1/4 1/2 3/4 Full				
DOWNSTREAM																		

Δ = Indicates failure

Table 8-7. Post-2000 Cycle Leak Test Data

TEST DATA SHEET

Specimen No. _____

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM														0 1/4 1/2 3/4 Full				
	Internal Seat	GH_2	-418	+40	18	100	0	50 50	2.8 0	33.5 42.0				0 1/4 1/2 3/4 Full				
DOWN STREAM																		

△=Indicates Failure

Table 8-8. Post-2500 Cycle Leak Test Data

TEST DATA SHEET — Specimen No. 1

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM														0 1/4 1/2 3/4 Full				
	Internal Seat	GH_2	-300	48	12	100 100	0 0	50 50	2.8 0	6.0 5.5				0 1/4 1/2 3/4 Full				
DOWN STREAM																		

Table 8-9. Post-3000 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 1

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act.	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Internal Seat	GH_2	-418	45		100	0	20	2.8	15.5	0			0 1/4 1/2 3/4 Full				
UPSTREAM	Internal Seat	GH_2	-418			100	0	0	0	20								
UPSTREAM	Internal Seat	GH_2	-400			100	0	50	2.8	11.5	seem	OK	OK	0 1/4 1/2 3/4 Full		* 6.0 9.1 12.2 15.6	4.1	4.0
DOWNSTREAM	Internal Seat	GH_2	-418			0	25	20	2.8	7.8	0		OK					
DOWNSTREAM	Loss of psi	GH_2	-418				25	0	0	11.0	0							
DOWNSTREAM	Internal Seat	GH_2	-418				25	50	2.8	7.0	0							

* Valve cracks at 3.0 Signal pressure

Table 8-10. Post-100 Cycles Functional Test Data

TEST DATA SHEET

Specimen No. 2

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Internal Seat	GH_2	-418	65	30	100		20	2.9	3.0	0	OK	OK	0	4503	2.9		
														1/4		6.8		
														1/2		10.0	11.5	5.2
														3/4		12.9		
														Full	1.2			
	Loss of psi	GH_2	-418	65	30	100		0	0	2.0	0							
	Internal Seat	GH_2	-418	65	30	100		50	2.9	2.0	0	OK	OK	0	4503	2.9		
														1/4		6.3		
														1/2		9.5	4.0	5.0
														3/4		12.5		
														Full	1.2	15.0		
DOWNSTREAM	Internal Seat	GH_2	-418	65	30		25	20	2.9	14.4	0							
	Loss of psi	GH_2	-418	65	30		25	20	2.9	5.6	0							
	Internal Seat	GH_2	-418	65	30		25	0	0	10.0	0							

Table 8-11. Post-500 Cycles Functional Test Data

TEST DATA SHEET — Specimen No. 2

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat	LH_2	-418	+65	20	100		20	2.9	0	0			0	4511	2.9		
														1/4		6.9		
														1/2		10.1	5.8	5.8
														3/4		12.8		
														Full	1.3	15.0		
	Loss of psi	LH_2	-418	+65	20	100		0	0	0	0							
	Loss of psi	LH_2	-418	+65	20	100		50	2.9	0	0			0	4511	2.9		
														1/4		6.1		
														1/2		9.1	4.0	5.0
														3/4		12.3		
														Full	1.3	15.0		
DOWN STREAM	Internal Seat	LH_2	-418	+65	20	0	25	20	2.9	0								
	Loss of psi	LH_2	-418	+65	20	0	25	0	0	0								
	Internal Seat	LH_2	-418	+65	20	0	25	50	2.9	0								

Note: Valve cracks @ 50 psig at 3.1 signal pressure

Table 8-12. Post-1000 Cycles Functional Test Data

TEST DATA SHEET

Specimen No. 2

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat	GH_2	-418	69.1	25	100		20	2.9	520 Δ				0	4511	2.9		
														1/4		6.3		
														1/2		10.2	5.6	5.3
														3/4		12.3		
														Full	252	15.0		
	Loss of psi	GH_2	-418	69.1	25	100		0	0	33.9 Δ								
	Internal Seat	GH_2	-418	69.1	25	100		50	2.9	86.7 Δ				0		2.9		
														1/4		6.0		
														1/2		9.1		
														3/4		11.9		
														Full		15.0		
DOWN STREAM	Internal Seat	He	-407	69	25		25	20	2.9	excessive * Δ								
	Loss of psi	He	-407	69	25		25	0	0	excessive Δ								
	Internal Seat	He	-407	69	25		25	50	2.9	excessive Δ								

* A decrease in signal pressure from 2.9 to zero did not stop leakage. Testing discontinued

Δ= indicates failure

Table 8-13. Post-100 Cycle Functional Test Data

TEST DATA SHEET — Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Internal Seat	LH_2	-418	65	30	100	0	25	2.5	0	0	OK	OK	0	4887			
														1/4		6.0		
														1/2		9.5	14.2	5.8
														3/4		12.5		
														Full	216	15.0		
	Loss of psi	LH_2	-418	65	30	100	0	0	0	0	0	OK	OK					
	Internal Seat	LH_2	-418	65	30	100	0	50	2.5	0	0	OK	OK	0	4887			
														1/4		5.7		
														1/2		8.8	3.4	5.8
														3/4		11.8		
														Full	216	15.0		
DOWNSTREAM	Internal Seat	LH_2	-418	65	30	0	25	25	2.5	0	0							
	Loss of psi	LH_2	-418	65	30	0	25	0	0	0	0							
	Internal Seat	LH_2	-418	65	30	0	25	50	2.5	0	0							

Table 8-14. Post-500 Cycle Functional Test Data

TEST DATA SHEET

Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat	LH_2	-418	65	20	100	0	25	2.6	0	0	OK	OK	0	4907	2.6	14.0	5.8
														1/4		6.0		
														1/2		9.4		
														3/4		12.5		
														Full	315	15.0		
	Loss of psi	LH_2	-418	65	20	100	0	0	0	0	0	OK	OK					
	Internal Seat	LH_2	-418	65	20	100	0	50	2.6	0	0	OK	OK	0	4907	2.6	3.7	5.8
														1/4		6.0		
														1/2		9.1		
														3/4		12.1		
														Full	315	15.0		
DOWN STREAM	Internal Seat	LH_2	-418	65	20	0	25	25	0	0	0							
	Loss of psi	LH_2	-418	65	20	0	25	0	0	0	0							
	Internal Seat	LH_2	-418	65	20	0	25	50	0	0	0							

Table 8-15. Post-1000 Cycles Functional Test Data

TEST DATA SHEET

Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat	LH_2	-418	69.1	25	100	0	25	2.5	15.8△	0	OK	OK	0	4910			
														1/4		5.8		
														1/2		9.1	14.1	5.8
														3/4		12.0		
														Full	314	15.0		
	Loss of psi	LH_2	-418	69.1	25	100	0	0	0	2.8	0	OK	OK					
	Internal Seat	LH_2	-418	69.1	25	100	0	50	2.4	6.6	0	OK	OK	0	4910			
														1/4		5.8		
														1/2		8.8	3.8	5.8
														3/4		11.8		
														Full	314	15.0		
DOWN STREAM	Internal Seat	LH_2	-418	71	25	0	25	25	2.4	4.2	0							
	Loss of psi	LH_2	-418	71	25	0	25	0	0	4.0	0							
	Internal Seat	LH_2	-418	71	25	0	25	50	2.4	4.2	0							

△=Indicates failure

Table 8-16. Post-3000 Cycles Functional Test Data

TEST DATA SHEET

Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UPSTREAM	Internal Seat	LH_2	-418	65	1	100	0	25	2.4	36.4 △	0	OK	OK	0	4915	2.4		
														1/4		5.8		
														1/2		9.0	14.0	5.6
														3/4		12.1		
														Full	315	15.0		
	Loss of psi	LH_2	-418	65	1	100	0	0	0	17.6 △	0							
	Internal Seat	LH_2	-418	65	1	100	0	50	2.4	42.9 △	0			0	4915			
														1/4		5.8		
														1/2		8.2	3.8	3.3
														3/4		12.1		
														Full	315	15.0		
DOWNSTREAM	Internal Seat	He	-407	65	1	0	25	25	2.4	7.3	0							
	Loss of psi	He	-407	65	1	0	25	0	0	6.2	0							
	Internal Seat	He	-407	65	1	0	25	50	2.4	5.0	0							

△ = Indicates failure

Table 8-17. Post-Readjustment of Specimen

TEST DATA SHEET

Specimen No. 3

	Phase	Media	Temperature °F		Vacuum microns	Pressure Psig		Domotor Pressure Psig		Leakage sccm		Switches		Indicator			Stem Travel Secs.	
			Inner	Outer		In	Out	Act	Sig	Int	Ext	Open	Close	% Open	Res Ohms	Sig Psi	Open	Close
UP STREAM	Internal Seat	LH_2	-418	38	4	100	0	25	2.9	13	0			0 1/4 1/2 3/4 Full		6.1 9.4 12.4 15.0	8.0	4.1
	Loss of psi	LH_2	-418	38	4	100	0	0	2.9	33 △	0							
	Internal Seat	LH_2	-418	38	4	100	0	50	2.9	160.0 △	0			0 1/4 1/2 3/4 Full		6.2 9.3 12.3 15.0	3.0	4.2
DOWN STREAM	Internal Seat	He	-407	38	4	0	25	25	2.9	8.0	0							
	Loss of psi	He	-407	38	4	0	25	0	2.9	7.0	0							
	Internal Seat	He	-407	38	4	0	25	50	2.9	4.0	0							

△ = Indicates failure

Note: All lines ¼ inch unless otherwise indicated.
Refer to table 8-1, for item identification.

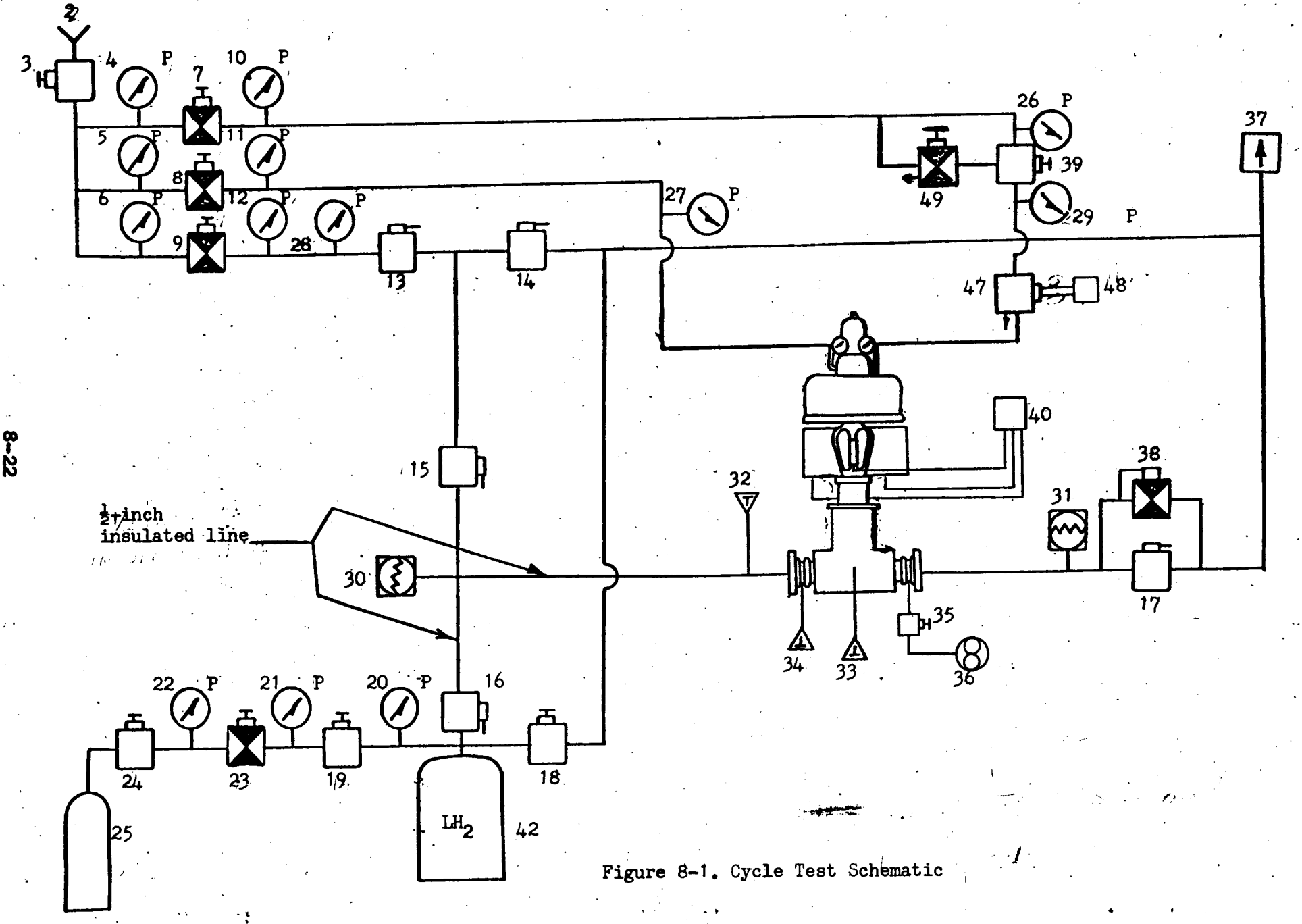


Figure 8-1. Cycle Test Schematic

Note: Refer to table 8-1 for item identification.

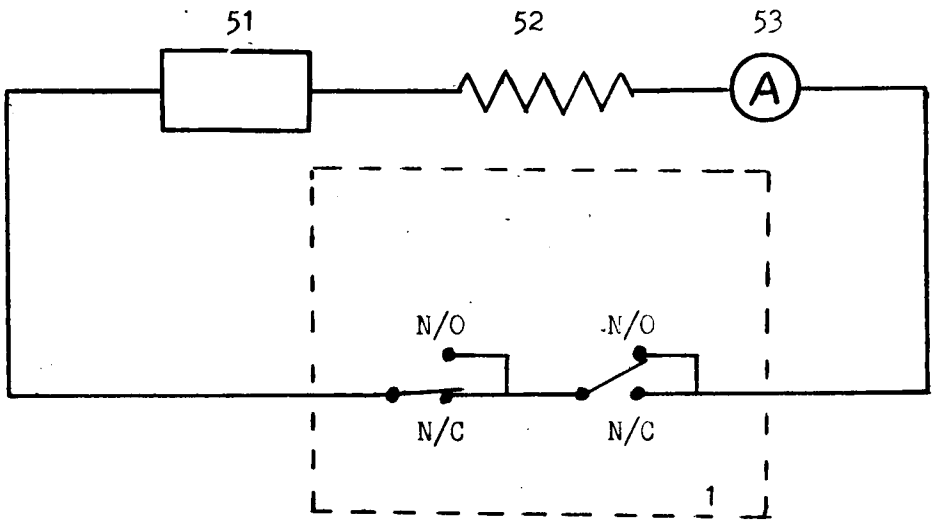


Figure 8-2. Cycle Test Electrical Schematic

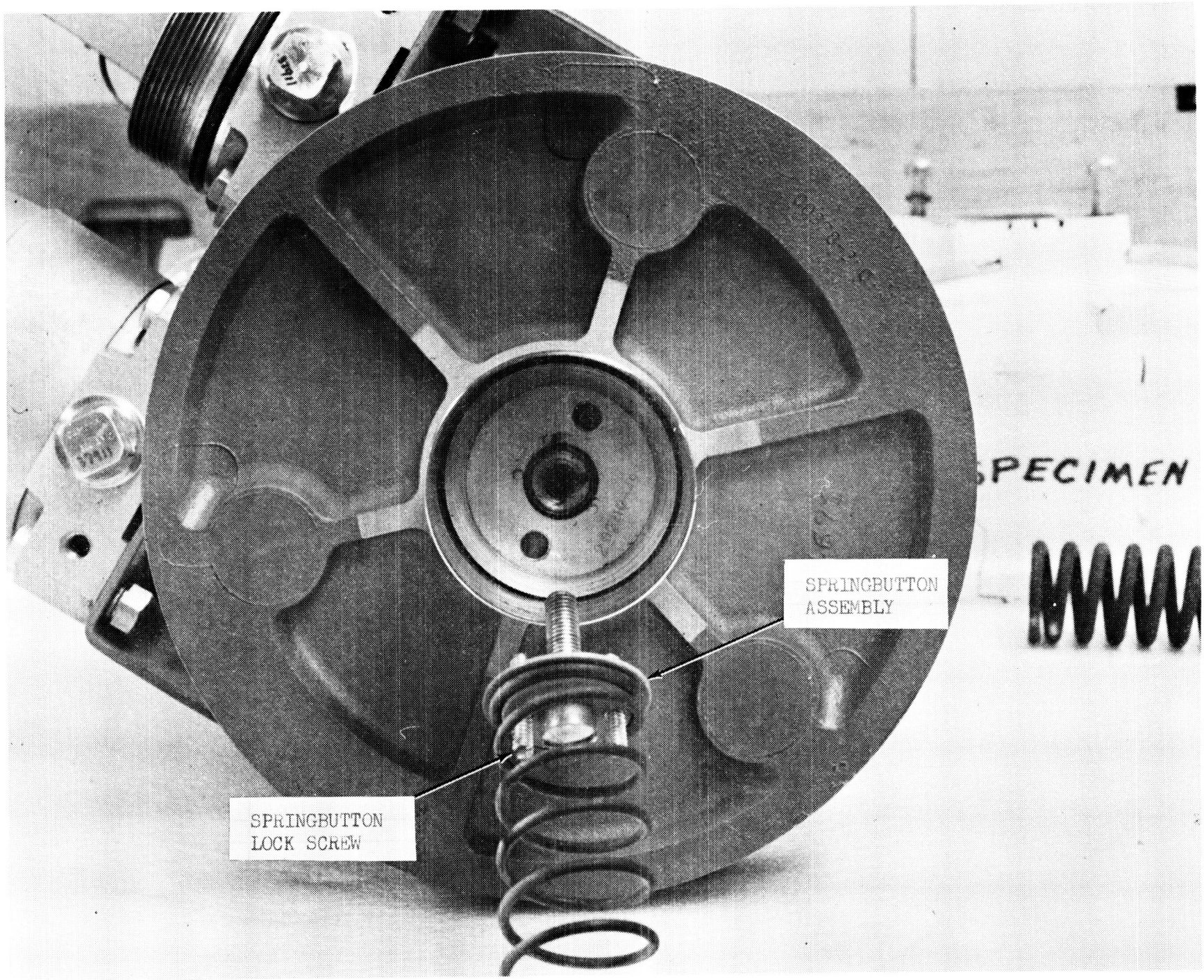


Figure 8-3. Failure of Springbutton on Specimen Number 1

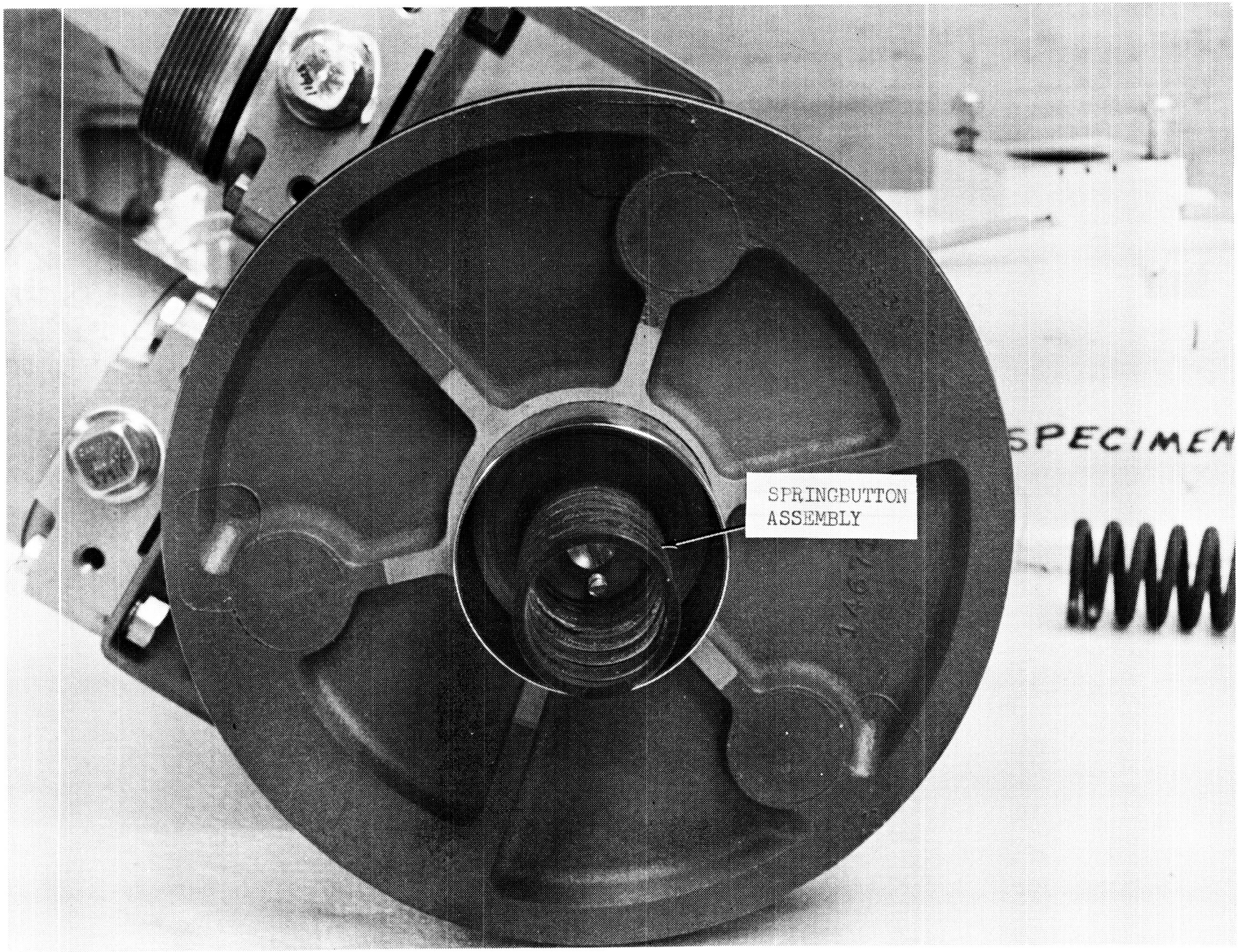


Figure 8-4. Specimen Number 1 Springbutton Assembly

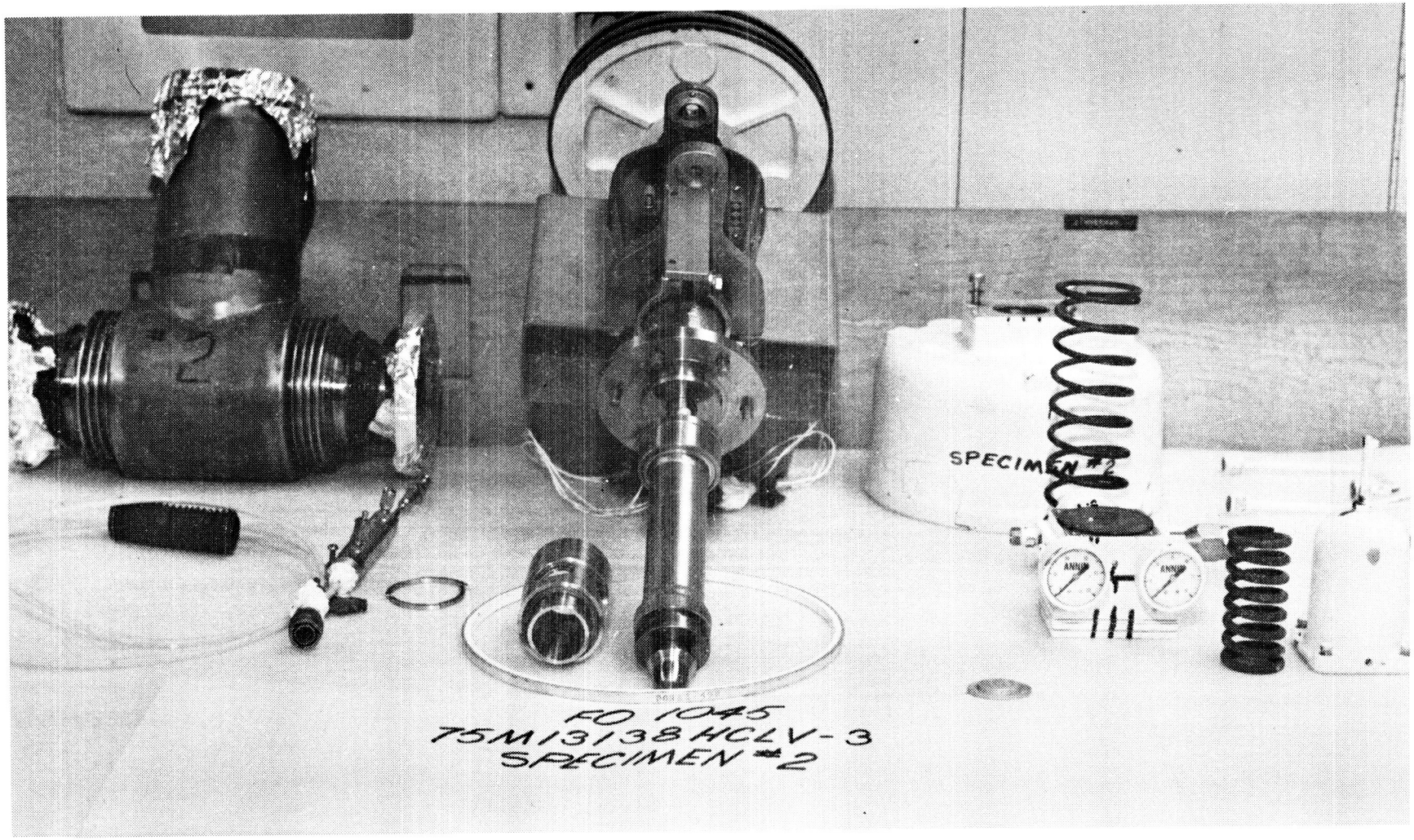


Figure 8-5. Disassembly of Specimen Number 2

Figure 8-6. Seal Creavey, Specimen Number 2

APPROVAL

TEST REPORT

FOR

GLOBE VALVE, 1-½-INCH, 100-PSIG,

PNEUMATICALLY OPERATED

ANNIN COMPANY MODEL NUMBER 1760-15016ASA

NASA Drawing Number 75M13138 HCLV-3

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